Five-Year Review Outcome of Microvascular Free Flap in Siriraj Hospital

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Background: *Microvascular free flap operation has become the preferred reconstructive technique at many medical centers to cover complex defects from tumor ablative surgery or trauma and for reconstructive procedure such as functioning muscle transfer. There are many clinical reports about free tissue transfer since the beginning of microvascular technique in the early 1960s. The overall success rate is about 90 to 98% but there may be postoperative complications.*

Objective: *Retrospectively analyze outcome and complications of consecutive series of microvascular free flap procedures, and compare with series published by other center.*

Material and Method: *The chart review was conducted of all patients that underwent microvascular free tissue transfer in our hospital between January 2007 and December 2011. The age, gender, underlying disease, other risk factors (smoking, obesity, pre-operative radiation on recipient site), American Society of Anesthesiologists (ASA) classification, indication for surgery, location of defect, type of flap, operative time, inflow and outflow vessel, type of anastomosis, vein graft usage, ischemic time, length of hospital stay, length of intensive unit stay, flap success rate, re-exploration surgery, salvage rate, and perioperative complications of all patient were noted. These data were collected in database and were available for statistical analysis.*

Results: *Between January 2007 and December 2011, 153 microvascular tissue transfers were performed to coverage and reconstruct various kind of defects and diseases. There were 102 men and 51 women, age ranged from 11 to 84 years (mean 48 years). There were 50 patients over 60 years old (33%). Among the 153 procedures, there were 124 defects from tumor ablation, 14 procedures for wound coverage including defect from acute trauma in five patients, and other procedure such as functioning muscle transfer and sex reassignment surgery. The microvascular free flap reconstruction of various kinds of indication all over the body showed success rate of 92.8%. Re-explorative surgery and ASA class more than 1 were significant factors influence with flap failure rate. Only significant factor associated with wound complication was age more than 60 years. ASA class more than 1 and age more than 60 years were significant factors that increasing general medical complication.*

Conclusion: *Microvascular free flap was the versatile reconstructive option. The failure rate of them should not be more than 5%. Factors associated with flap failure were re-exploration, ASA classification and factors that affect complications were preoperative morbidity level (ASA) and elderly patient.*

Keywords: *Microvascular free flap, Factors that influence with flap failure, Outcome of free flap reconstruction*

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Microvascular free flap operation has become preferred reconstructive technique at many medical centers to cover complex defects from tumor ablative surgery or trauma and for reconstructive procedure such as functioning muscle transfer. There are many clinical reports for free tissue transfer since the beginning of microvascular technique in the early 1960s[1-5]. During this period, refinement in microsurgical techniques and use of various donor sites has increased the surgical indication for extensive resection of pathologic lesion. Current experience demonstrates that microvascular free tissue transfer frequently allows for reliable, single stage and immediate reconstruction in more complex defect from various etiology[6-17]. Many large patient series were reported high flap success rate. However, this type of operation permits advanced disease to be more aggressively treated by surgery in patients with advanced age and high prevalence of coexisting illnesses, complications are common.

The aim of the present study was to retrospectively analyze outcome and complications of consecutive series of microvascular free flap procedures,

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to critical review of so-far result, and compare with series published by other center. We identified the variables that influence both flap success rate and perioperative complications by analyzing series of microvascular free tissue transfer performed at our academic center in the last 5-years.

Material and Method

Study design

The chart review was conducted of all patients who underwent microvascular free tissue transfer in our hospital between January 2007 and December 2011. The age, gender, underlying disease, other risk factors (smoking, obesity, pre-operative radiation on recipient site), American Society of Anesthesiologists (ASA) classification, indication for surgery, location of defect, type of flap, operative time, inflow and outflow vessel, type of anastomosis, vein graft usage, ischemic time, length of hospital stay, length of intensive unit stay, flap success rate, re-exploration surgery, salvage rate, and perioperative complications of all patient were noted. These data were collected in database and were available for statistical analysis.

Surgical technique

Two team approaches were performed in almost all cases. Microvascular anastomosis was performed by attending staff or training chief resident under close supervision of attending staff. Most of the patients were given low-molecular weight dextran post-operatively for five days. Flap viability was monitored by close clinical observation and occasional by Droppler ultrasonography.

Data assessment

Operative time was defined as the time between the first incision and wound closure. Ischemic time was defined as the time from transected of vascular pedicle to complete arterial anastomosis and release vascular clamp. Flap success rate was defined as complete flap viability or partial flap loss that still achieved primary indication of surgery[18]. A complication was divided into flap related complications and general medical complications.

Statistical analysis of data was performed using the Statistical Package for the Social Sciences (SPSS). Chi-square and Fisher's exact test were used to statistically compare variable that influence with flap success rate and perioperative complications. A *p*-value of 0.05 or less was regarded as statistically significant.

Results

Between January 2007 and December 2011, 153 microvascular tissue transfers were performed to coverage and reconstruction various kind of defects and diseases. There were 102 men and 51 women ranging in age from 11 to 84 years (mean 48 years). There were 50 patients over 60 years old (33%). Among the 153 procedures, there were 124 defects from tumor ablation, 14 procedures for wound coverage including defect from acute trauma in five patients, and other procedure such as functioning muscle transfer and sex reassignment surgery.

Most of these defects were in head and neck region, 79.7%. The most common flap type was fibula free flap (62 flaps, 41%), followed by the anterolateral thigh (ALT) flap (34 flaps, 22%). Inflow artery that used for anastomoses varied, superior thyroid (40%) was the most common, followed by facial artery and superficial temporal artery (25% and 19%, respectively). For venous anastomoses the superior thyroid vein (21%), facial vein (18%), superficial temporal vein, and external jugular vein were the most common. Most of anastomoses were end to end (95%), and vein graft were used only 4.6%. Mean duration of operation including surgical resection was 11.5 hours (range 4-26.8 hours), mean ischemic time was 90 minutes (range 20-300 minutes). Post-operative admission to intensive care unit in 133 patients (87%) with mean length of intensive unit stay 3.1 days, total hospital stay 34 days (Table 1).

The overall flap success rate was 92.8%. Re-exploration for anastomosis revisions were performed in 12 patients (7.8%) with eight flaps salvaged. Most of re-explorations were only one time but one case received three re-exploration and two cases had two re-explorations. Four of these procedures occurred in the first 24 hours post-operative, which have salvage rate of 67%. This is a better salvage rate than the group that performed re-exploration after 24 hours (62.5%), but not statistically significant. Wound complication including hematoma, infection, and wound dehiscence was 49.7%, general complication including pneumonia, cardiac related, sepsis, and delirium was 27.5% (Table 2).

The amount of microvascular free flap operation in our unit was increased every year from 26 cases in 2007 to 36 cases in 2010, but in 2011, total case was decreased due to major flood problem in Bangkok in the fourth trimester, which affected the amount of elective surgical cases. Flap failure rate

Table 1. Patients demographic and clinical data (n = 153)

Sex	
Male	102 (67.0)
Female	51 (33.0)
Age (years)	
Mean age (range)	48 (11-84)
<60	103 (67.0)
≥60	50 (33.0)
ASA class (n = 151)	
I	60 (39.7)
II	78 (51.7)
III	13 (8.6)
Underlying disease and other risks	
Diabetes mellitus	14 (9.2)
Smoking	70 (45.8)
Pre-operative radiation in recipient site	17 (11.1)
Obesity	5 (3.3)
Etiology of defect	
Tumor ablation	124 (81.0)
Wound coverage	14 (9.2)
Functioning muscle transfer	8 (5.2)
Others	7 (4.6)
Recipient site	
Head and neck	122 (79.7)
Scalp	9 (5.9)
Extremity	16 (10.5)
Breast	3 (2.0)
Others	3 (2.0)
Donor site	
Fibula	62 (40.5)
Anterolateral thigh (ALT)	34 (22.0)
Gracilis	19 (12.4)
Radial forearm	18 (11.8)
Latissimus dorsi	7 (4.6)
Rectus abdominis/deep inferior epigastric perforator	7 (4.6)
Others	6 (3.9)
Ischemic time (minutes), mean (range)	89.9 (20-300)

ASA = American Society of Anesthesiologists
Data are number (%) unless otherwise stated.

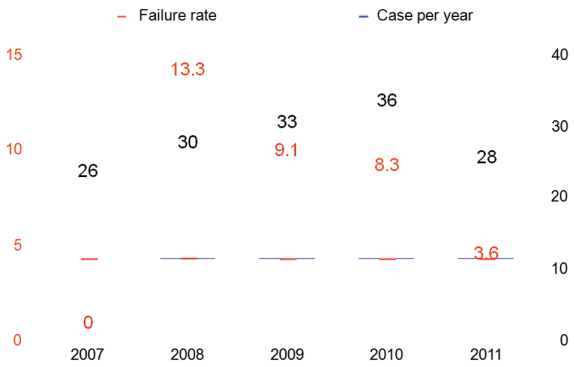

Fig. 1 Amount of case and flap failure rate per year.

Table 2. Flap outcome and complication

Flap outcome	
Success rate	142 (92.8)
Total flap necrosis/critical partial flap failure	11 (7.2)
Re-exploration	12 (7.8)
Salvaged flap (n = 12)	8 (67.0)
Wound complication (one or more complication)	Total 49.7%
Surgical site infection	47 (31.0)
Wound dehiscence	30 (20.0)
Hematoma	27 (18.0)
Others	5 (3.0)
General medical complication (one or more complication)	Total 27.5%
Pneumonia	32 (21.0)
Delirium	18 (11.8)
Cardiac relate	5 (3.3)
Sepsis	4 (2.6)
Others	6 (3.9)

Data are number (%) unless otherwise stated.

Table 3. Factors associate with flap failure

Factors	Rate of flap failure, n (%)	*p*-value*
No re-explore (n = 141)	7 (5.0)	0.005
Re-exploration surgery (n = 12)	4 (33.0)	
No vein graft use (n = 103)	4 (3.9)	0.215
Vein graft interposition (n = 5)	1 (20.0)	
ASA class I (n = 60)	0 (0)	0.003
ASA class II/III (n = 91)	11 (12.1)	

* Fisher's exact test

tended to decrease from overall failure rate of 7.2 to 3.6% in 2011 (Fig. 1).

Significant factors associated with flap failure were need for re-exploration surgery (p = 0.005) and ASA class II and III compared with ASA class I (p = 0.003). Vein graft interposition and other risk factors were not significantly associated with flap failure (Table 3). Age more than 60 years was the only significant factor associated with wound complication (p = 0.034). ASA class II and III compare with ASA class I (p = 0.004) and age more than 60 years (p<0.001) were significant factors for general medical complication. Pre-operative radiation and smoking tended to increase both wound and general medical complication but not statistically significant (Table 4).

Discussion

A major change in the reconstruction of defect in various locations was the introduction of free vascularized tissue transfer in 1960s and 1970s, which

Table 4. Factors associated with wound and general medical complication

Factors	Wound complication		General medical complication	
	Complication, n (%)	*p*-value*	Complication, n (%)	*p*-value*
Age <60 years (n = 103)	45 (43.7)	0.034	24 (48.0)	<0.001
Age ≥60 years (n = 50)	31 (62.0)		18 (17.5)	
ASA class I (n = 60)	25 (41.7)	0.143	9 (15.0)	0.004
ASA class II/III (n = 91)	49 (53.8)		33 (36.3)	
No DM (n = 139)	67 (48.2)	0.251	40 (28.8)	0.352+
DM (n = 14)	9 (64.3)		2 (14.3)	
No pre-operative RT (n = 136)	66 (48.5)	0.424	36 (26.5)	0.564+
Pre-operative RT (n = 17)	10 (58.8)		6 (35.3)	
Non-smoker (n = 83)	40 (48.2)	0.690	18 (21.7)	0.082
Smoker (n = 70)	36 (51.4)		24 (34.3)	

DM = diabetes mellitus; RT = radiation therapy
* Chi-square
+ Fisher's exact test

Table 5. Free flap failure rate

Author	Number of flaps	Recipient site	Success rate (%)
Present study	153	All area	92.8
Wei et al.[21]	3,361	Head & neck & extremity	98.4
Nakatsuka et al.[12]	2,372	Head & neck	95.8
Chen et al.[32]	1,142	All area	96.4
Chubb et al.[30]	1,140	All area	96.9
Kroll et al.[19]	854	Head & neck & breast	96.3
Srikanth et al.[18]	768	All area	95.0
Acosta et al.[17]	675	Breast	90.7-98.2
Pohlenz et al.[15]	540	Head & neck	93.8
Eckardt et al.[14]	534	Head & neck	95.0
Khouri et al.[20]	493	All area	95.9
Suh et al.[13]	400	Head & neck	99.7

enabled primary reconstruction of more complex and extensive defect. This procedure has largely replaced traditional surgical concepts of multiple stage reconstruction using pedicle and local flaps[8,9,11,12,14,16].

From the previous studies, the overall failure rate of microvascular free flap reconstruction were 5 to 10%[12-15,17-21,30,32]. Most of them were head and neck reconstruction. Our institution had conducted the microvascular free flap reconstruction more than 10 years ago, but we did not have any long-term study about them. The present study was the largest microvascular free flap volume in Thailand that ever had[34-40]. This retrospective review presented our last 5-years clinical experience of 153 procedures of microvascular free flap reconstruction of various kinds of indication all over the body, showed success rate of 92.8%, which is approximate agreement with other series with success rate exceeding 90%[12-15,17-21,30,32] (Table 5). The majority of patients (81%) suffered from tumor ablative surgery, and majority of defects (79.7%) were in head and neck region. Evaluating the results of diverse reconstruction procedure from difference site of defect was extremely difficult. The functional assessment of each flap was limited for comparative analysis, due to retrospective nature of our review.

During the present study period, fibula osteocutanous flap was still our preferred donor site for reconstruction of bony defect, because it provides an excellent length of bone, and can tolerate multiple osteotomies. It also can well adapting to mandibular defect[8,9,11]. However, today the ALT flap has become our choice for reconstruction of soft tissue defect

compare to previous preferred radial forearm free flap in the early experience in our center similar to many centers. The ALT provides long vascular pedicle, ability to include muscle into the flap, and very low donor site morbidity. Although, there was some series that report the same level of donor site morbidity compare to radial forearm flap[26-29].

Re-exploration rate in our study was 7.8% with salvage rate of 67%, which was comparable to 1.75 to 25.5% re-exploration rate and 27 to 84% of salvage rate in other studies[1-4,7,9,12-16,19-21,25,30,32]. Re-exploration that occurred within first 24 hours tend to have more salvage rate compared to group that performed re-exploration after 24 hours, but not statistically significant in our study, which many authors believed that earlier re-exploration had better salvage rate but this topic is still debated[30-33].

With any free flap operation, complication may occur at surgical site or systemically. Report of complications in the literature varied, depending on population of study, definition of complication report, method of data collection, etc. Overall report of complication was 12 to 47%. Our report showed high wound complication rate 49.7%, compared to others study may be due to the inclusion of minor surgical site infection, which was high as 31%. About general medical complication rate of 27.5% was comparable to other studies[4,13,16,17,19,20,24].

Factors that influence with flap failure rate and complications were still debated although many studies try to identified it with prospective or retrospective manner[7,14,19,20,22-25,32,33]. Reported factors that related to flap failure were patients pre-operative status, age, smoking, pre-operative radiation, osteomyelitis flap type, surgical expertise, use of vein graft, operative time, and re-exploration for anastomosis revision, but still not have sufficient large prospective data to definitely identified all significant cause[7,19,20,22-25,32,33]. About factor that related to wound complication and general complication were age, ASA class, diabetes mellitus, pre-operative radiation, smoking, and alcohol consumption also reported, but lack of large prospective data enough for definitely identified all significant causes as well[7,14,20,22-25,32,33]. In our retrospective report, re-explorative surgery and ASA class more than 1 were significant factors influence with flap failure rate. Only significant factor associated with wound complication was age more than 60 years. ASA class more than 1 and age more than 60 years were significant factors that increased general medical complication.

About surgical experience, the incidence of microvascular free flap was tended to increase every year and failure rate was decreased corresponded to the increasing surgical expertise. Although number of our data were still limit for comparative analytic result per year.

Conclusion

Microvascular free flaps are reliable in achieving successful reconstruction in various defects of body. Factors associated with flap failure were re-exploration, ASA classification and factors that affect complications were preoperative morbidity level (ASA) and elderly patient. These results presented a current baseline for free flap surgery to which future advances and improvement in technique and practice may compared.

What is already known on this topic?

From the previous studies, the overall failure rate of microvascular free flap reconstruction was 5 to 10%[12-15,17-21,30,32]. Most of them were head and neck reconstruction. Our institution had conducted the microvascular free flap reconstruction more than 10 years ago, but we did not have any long-term study about them. The present study is the largest microvascular free flap volume in Thailand ever reported.

Factors that influence with flap failure rate and complications were still debated, although many studies try to identified it with prospective or retrospective manner[7,14,19,20,22-25,32,33]. Reported factors that related to flap failure were patients pre-operative status, age, smoking, pre-operative radiation, osteomyelitis flap type, surgical expertise, use of vein graft, operative time, and re-exploration for anastomosis revision, but still did not have sufficient large prospective data to definitely identified all significant cause[7,19,20,22-25,32,33]. About factors that related to wound complication and general complication were age, ASA class, diabetes mellitus, pre-operative radiation, smoking, and alcohol consumption also reported, but lack of prospective data large enough for definitely identified all significant cause as well.

What this study adds?

This retrospective review presented our last 5-years clinical experience of 153 procedures of microvascular free flap reconstruction of various kinds of indication all over the body, showed success

rate of 92.8%, which is approximately agreed with other series with success rate exceeding 90%.

In our retrospective report, re-explorative surgery and ASA class more than 1 were significant factors influence with flap failure rate. Only significant factor associated with wound complication was age more than 60 years. ASA class more than 1 and age more than 60 years were significant factors that increasing general medical complication.

Potential conflicts of interest

None.

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ผลการศึกษา 5 ปีย้อนหลังของการผ่าตัดย้ายเนื้อเยื่อร่วมกับการต่อหลอดเลือดโดยการใช้กล้องจุลทรรศน์ในผู้ป่วยที่ได้รับการรักษาที่โรงพยาบาลศิริราช

ศิริชัย กำเนิดนักตะ, ณัทธร บูชางกูร

ภูมิหลัง: *ปัจจุบันมีผู้ป่วยจำนวนมากที่มีปัญหาการสูญเสียเนื้อเยื่อโดยสาเหตุพบตั้งแต่อุบัติเหตุไปจนถึงการผ่าตัดมะเร็งต่าง ๆ ศัลยแพทย์จำเป็นต้องทำการรักษาโดยการเสริมสร้างเนื้อเยื่อการผ่าตัดย้ายเนื้อเยื่อร่วมกับการต่อหลอดเลือดโดยผ่านกล้องจุลทรรศน์ เป็นมาตรฐานการเสริมสร้างเนื้อเยื่อชนิดหนึ่งที่มีความนิยมมากขึ้นตามลำดับ แต่ในการผ่าตัดย้ายเนื้อเยื่อร่วมกับการต่อหลอดเลือดโดยผ่านกล้องจุลทรรศน์ เป็นการผ่าตัดที่ซับซ้อน และมีปัจจัยหลายประการที่มีผลต่อความสำเร็จของการผ่าตัด ทั้งในแง่ของปัจจัยที่ตัวผู้ป่วยเอง ไปจนถึงเทคนิคในการผ่าตัด และการดูแลหลังผ่าตัด โดยในต่างประเทศมีการศึกษาถึงความสำเร็จโดยวิธีนี้อยู่ที่ 90 ถึง 98% ซึ่งมีการรายงานการเกิดภาวะแทรกซ้อนที่ตามมาภายหลังด้วยเช่นกัน*

วัสดุและวิธีการ: *การศึกษานี้ทำการเก็บรวบรวมข้อมูลของการผ่าตัดย้ายเนื้อเยื่อร่วมกับการต่อหลอดเลือดโดยผ่านกล้องจุลทรรศน์ที่โรงพยาบาลศิริราช สาขาศัลยกรรมตกแต่ง ในช่วง เดือนมกราคม พ.ศ. 2550 จนถึง ธันวาคม พ.ศ. 2554 จำนวน 153 ราย โดยเก็บข้อมูลพื้นฐานของผู้ป่วยโดยทั่วไป โรคประจำตัว ความแข็งแรงร่างกายก่อนผ่าตัด (ASA class) การสูบบุหรี่ น้ำหนัก ส่วนสูง รวมถึงเทคนิคการผ่าตัด ผลความสำเร็จของการผ่าตัด การผ่าตัดซ้ำ การครองเตียง และภาวะแทรกซ้อนหลังผ่าตัด*

ผลการศึกษา: *พบมีจำนวนผู้ป่วยที่ได้รับการผ่าตัดโดยการย้ายเนื้อเยื่อทั้งสิ้น 153 ราย เป็นชาย102 ราย และเป็นหญิง 51 ราย อายุ 11 ถึง 84 ปี เป็นการแก้ไขหลังผ่าตัดเนื้องอก 124 ราย จากการผ่าตัดปิดบาดแผล 14 ราย จากบาดแผลจากอุบัติเหตุ 5 ราย ที่เหลือเป็นจากการผ่าตัดอื่น ๆ เช่น การแปลงเพศ การย้ายกล้ามเนื้อ เป็นต้น โดยพบอัตราความสำเร็จโดยรวมในช่วงเวลาดังกล่าวอยู่ที่ 92.8% โดยพบว่าปัจจัยที่มีผลต่อการผ่าตัดสำเร็จขึ้นอยู่กับการผ่าตัดซ้ำ และสุขภาพโดยรวมของผู้ป่วยก่อนผ่าตัด (ASA class) ส่วนปัจจัยที่มีผลต่อภาวะแทรกซ้อนทางอายุรกรรม คือ อายุมากกว่า 60 ปี และสุขภาพโดยรวมของผู้ป่วยก่อนผ่าตัด (ASA class) มากกว่าระดับ 1*

สรุป: *การผ่าตัดย้ายเนื้อเยื่อโดยการต่อหลอดเลือดร่วมด้วยเป็นการผ่าตัดที่มีประสิทธิผล โดยความล้มเหลวจากการผ่าตัดพบน้อยกว่า 5% และจากผลการศึกษาพบว่าสิ่งที่มีผลต่อความสำเร็จคือ การผ่าตัดซ้ำ ความแข็งแรงร่างกายก่อนผ่าตัด (ASA class) ส่วนปัจจัยที่มีผลต่อภาวะแทรกซ้อน คืออายุมากกว่า 60 ปี และสุขภาพโดยรวมของผู้ป่วยก่อนผ่าตัด (ASA class) มากกว่าระดับ 1*