Micro Vascular Free Tissue Transfer Surgeries : Impact of a Designed Teaching Protocol on Nurse's Performance for Reduction or Prevention of Post Operative Flap Failure

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Abstract: Introduction: Micro vascular transplants, also known as a free flap or free tissue transfer, involves transplanting nonessential donor tissue from one part of the body to another to restore form or function using microsurgical techniques. The transplanted tissue must have a single blood supply with an artery and draining vein that are both adequate to sustain circulation and life in the transplant. The free flap is anastomosed (blood vessels connected) to the recipient vessels and blood flow is re-established. Aim of the study is 2-fold: first: to design a teaching protocol for nurses working with patients undergoing microvascular free tissue transfer surgeries, and second: to evaluate the effect of implementing the designed teaching protocol on nurse's performance for reduction or prevention of post operative flap failure. Quasi-experimental research design has been utilized in this study. Subjects and Methods: A study was conducted in Assiut University Hospitals. A sample of convenience including all nurses working in Reconstructive Microsurgical Unit (10) & Traumatology Care Unit (20) in addition to (30) patients with free tissue transfer surgeries. Tools utilized were:-a) Nurses performance regards care of patients undergoing free tissue transfer surgeries questionnaire sheet to assess nurse's knowledge in addition to some sociodemographic data.b) Nurses performance regards care of patients undergoing free tissue transfer surgeries observation checklist sheet to assess nurse's skills. c) Flap observation checklist sheet among patients undergoing free tissue transfer surgeries to monitor postoperative free tissue transfer surgeries complications , D) Patients assessment sheet for free tissue transfer surgeries to assess flap failure that might develop among all patients admitted to reconstructive microsurgery. Results: A sharp improvement in the mean knowledge and practice scores were found after the application of the teaching protocol. The flap failure decreased from 20% pre-protocol to 3.3% after protocol implementation. A positive correlation was found between nurse's knowledge and practice scores immediately and 2 months after application of the teaching protocol. A significant relationship was found between flap failure and other complications as regards hyperthermia, pain, venous and arterial obstruction. Venous and arterial obstructions are significantly correlated with ischemia time. Conclusions and Recommendations: Patients with free tissue transfer surgeries are at high risk for postoperative complications, which in turn increase the development of the flap failure. These complications include hyperthermia, pain, infection, venous and arterial obstructions and need effective measures to prevent/reduce this considerable profound problem. Improving nurses' knowledge and practice can favorably affect the incidence and outcome of flap failure. Continued nursing education and in-service training programs on reconstructive microsurgery should be well organized within Assiut University Hospital and equipped with the necessary educational facilities and materials necessary to upgrade the knowledge and skills of practicing nurses, which will be reflected on better outcome and service for inpatients.

1. Introduction

The term "flap" originated in the 16th century from the Dutch word "flappe" meaning something that hung broad and loose, fastened only by one side .The flap as defined a unit of tissue that is transferred from one site (donor site) to another (recipient site) while maintaining its own blood supply. Flap classifications based on the type of tissue include: skin and fascia (cutanous flap) e.g. radial forearm flap, muscle (muscle flap), bone (osseous flap) and visceral (colon, small intestine, omentum), skin and tendon (tendocutaneous) and sensory innervated flaps (dorsalis pedis flap with deep peroneal nerve) Martins and Montero, (2007) .

Briggs, (2001) mentioned that successful free tissue transfer begins with proper patient selection. There are a number of patient characteristics which can additively increase likelihood of failure, these characteristics include the followings: age, diabetes and other systemic illness, microvascular diseases

(delay healing revascularization between the flap and surrounding tissue) decreased flap perfusion, hypercoagulation and obesity.

Most common complications of free flaps include loss of arterial supply which may cause necrosis (death) of the flap or loss of venous return which may cause congestion and also loss of the flap. We should differentiate between arterial and venous compromise. Risk of arterial occlusion increases within 24 hours postoperatively and venous congestion between 24 and 72 hours. Recognition of ischemia is important in preventing subsequent flap necrosis thus flap failure (Hitchinson and Williams, 2003, Stroch and Rice, 2005, and Woodberry, 2003)

The perioperative nurse must know the risk factors, creates and maintains a safe, effective environment, and classify the surgical wound. A complete assessment of the patient and surgical procedure is necessary .The preoperative nurse must inspect the micro-instruments and micro-scope to ensure proper function. Also she does a quick visual check of the room before set up and opening of sterile supplies. Three parameters of the operating room environment must be controlled to inhibit the growth of microorganisms. Humidity maintained at 30-60%, the rooms kept cooler at $21\,^{O}C$: $24\,^{O}C$ and ventilated through high-efficiency filters at a rate of 20-25 total room air exchanges per hour (Halvorson, 2002, Jones and Mayou, 2001 and John, 2003).

Preoperative teaching includes instructions in breathing and leg exercises used to prevent postoperative complications, such as pneumonia and deep vein thrombosis. One goal of preoperative nursing care is to teach the patient how to promote optimal lung expansion and consequent blood oxygenation after anesthesia. The patient assumes a sitting position to enhance lung expansion. The nurse then demonstrates how to perform breathing and coughing exercises (Potter and Perry, 2001).

Hassan, (2002) mentioned that it is advisable to observe patient after free tissue transfers surgery in a special high dependency unit or an intensive care unit (ICU), where the staff are well acquainted with the problem of this surgery. Postoperative monitoring includes the following: peripheral circulation (capillary return, skin temperature), pulse oximetry SaO2 greater than 90%, urine output greater than 1 ml/Kg/h. systolic blood pressure greater than 100 mmHg or mean arterial blood pressure greater than 75% mmHg, hemoglobin around 10 g/dl or hematocrit 25: 30 % (checked every 6 hours for 24 hours).

Briggs (2001) reinforced that proper care after free tissue transfer surgery requires personnel who understand the basic principles of free tissue transfer. Supplemental oxygen and humidified air will cool a superficial flap and inhibit its blood flow.

Hemodynamics and blood volume must be monitored closely. It is important to inform the intensive care unit personnel to avoid transfusing these patients without notifying the surgeon. Close surveillance for hematoma formation is necessary to avoid the deadly consequences of vascular compression. Blood pressure should be maintained appropriately.Close monitoring of the flap both by nurses and the surgeon is important postoperatively to monitor for this. If caught early, loss of blood supply may be corrected either medically or surgically.

Monitoring circulation of flaps post operatively is critical to success in free tissue transfer. Changes in perfusion need to be recognized quickly to correct any treatable problems. Disruption of perfusion to a flap can result in partial or complete flap loss. Monitoring the free flap during the postoperative phase is critical to ensure flap survival. When recognized early and managed promptly (<6 h), compromised flaps have a 75% salvage rate when taken back to the operating room. (Microsuregeon organization, 2005 and Holze, et al., 2006).

Hitchinson and Williams, (2003) designed an observation chart for free flap. This chart include: type and location of flap, color, temperature, capillary refill, and turgidity. As regards color if the flap is an external flap, check with the donor site for original color but if it is an internal flap, monitor for extremes of color. To measure temperature of the flap, an internal or external flap should always feel warm to the touch but if the flap feels cool or cold, the medical assessment should be sought immediately. As regards capillary refill, it should be timed in second if timing is not possible and an alteration in perfusion is suspected, the medical assessment should be sought immediately. The flap should usually feel spongy not hard or flaccid in relation to turgidity.

Punder, (2005) added that; all these observations should be recorded on a flap assessment chart .Flap should be observed ¼ hourly for the first 6 hours, ½ hourly for the subsequent 18 hours, hourly for the subsequent 48 hours. Reassess individually according to ongoing clinical needs. These timings have been developed following an in depth literature review and the authors' previous clinical experiences within the plastic surgical setting frequent and regular monitoring in the early post-operative phase allows for early detection and increased salvage ability of the flap. There is little justification to continue intensive flap monitoring after the first 3 days. These timings may alter if there is a change in flap perfusion. It must be emphasized that medical assessment should be sought immediately if there is any change in flap appearance.

Significance of study:

Reconstructive microvascular surgeries are recently introduced in Assiut university hospitals as a new surgical branch. This type of surgery is considered a critical one as the patient is threatened by flap failure especially during the first 48 hours postoperatively. Literature review cited many causes for flap failure, some could be classified as preoperative causes, and others can be classified as an intra and/or postoperative causes, in addition to the patient's related factors.

In addition to the scarce national researches performed into this area this research could be an attempt to equip this group of nurses with needed knowledge and practices that could contribute to flap success. As well it may provide some findings that could be helpful to patients, nurses and other health professionals to gain more knowledge about this clinical problem. It will also provide a data base about this specialized type of surgery. It is hoped also that this effort will generate attention and motivation for further investigation in this topic.

The aim of the study:

The aim of the present study is 2-fold: first is to design a teaching protocol for nurses working with patients undergoing microvascular free tissue transfer surgeries, and the second is to evaluate the effect of implementing the designed teaching protocol on nurse's performance for reduction or prevention of post operative flap failure

2. Subjects and Methods
Research design:
Quasi-experimental research design.

Sample:

A sample of convenience including all nurses working in Reconstructive Microsurgical Unit (10) and Traumatology Care Unit (20) who are willing to participate in the study and all patients admitted for free tissue transfer surgeries for at least six months after application of the designed teaching protocol.

Setting:

The study was conducted at the Reconstructive Microsurgical & Traumatology Care Units in Assiut University Hospital.

Tools:

Data pertinent to the study were collected, and utilizing the following four tools:

Tool I- Nurses performance regards care of patients undergoing free tissue transfer surgeries questionnaire sheet:

It was translated and modified by researcher to assess their knowledge about care of patient undergoing free tissue transfer, then a pilot study on five patients was done. According to the results of the pilot study, subjects were included in the study as the changes performed were minimal. It was used prior to implementation of the teaching protocol to measure the exact knowledge level of nurses about free tissue transfer surgeries. It was used immediately after the implementation of the teaching protocol (immediate post-test) in addition to two months later to evaluate the gain in knowledge after the intervention. It consists of (5) main parts:

- Demographic variables of biosocial characteristics of study sample (30 nurses), including age, residence, marital status, educational level, and duration of experience. It included (8) items .
- Nurses' knowledge about microsurgery and types of flap, which included (26) questions .
- Nurses' knowledge about nursing care before free tissue transfer surgeries, which included(17) questions.
- Nurses' knowledge about nursing care during free tissue transfer surgeries, which included (16) questions.
- Nurses' knowledge about nursing care after free tissue transfer surgeries, which included (33) questions.

The questionnaire sheet was administered by researcher to the nurses for answering all its components then collected. The total number of questions was (92).
Scoring system: each right answer was given one score. The total scores were (92). Those who obtained less than (50%) were considered having unsatisfactory level. From (50% to 70%) were considered having satisfactory level. While those who obtained above than (70) were considered having good level.

Tool II: Nurses performance regards care of patients undergoing free tissue transfer surgeries observation checklist sheet:

It was developed and modified by researcher to assess the learnt skills. This tool was used before and immediately after the implementation of the teaching protocol as well as two months later to evaluate the impact of the training teaching protocol on nurses' practice. It consists of the following (5) main items:

- General care of patient with free tissue transfer surgeries which includes (16) items.
- Specific care which includes(47) items as regards the following:
1. Activities to maintain body heat
2. Activities to keep bed rest

3. Activities to reduce pain & swelling.
4. Manage postoperative hypothermia.
5. Measures to reduce arterial or venous insufficiency.
- Postoperative monitoring of vascular viability of flap as regards color, temperature, turgor, capillary refill, dermal bleeding, and activities to perform pin-prick test. It includes (17) items.
- Care of wound and donor site which includes (19) items .
- Instructions about home care after microsurgery which includes (13) items.

The observation checklist was applied by researcher to evaluate the nurses' practice as regard identification, prevention and management of causes of flap failure. Scoring system: Each item was observed, categorized and scored into either 'done correctly =1, or not done =0. The total score for all items was 112. Those who obtained less than (50%) were considered having unsatisfactory level. From 50% to 70%)were considered having satisfactory level. While those who obtained above than 70% were considered having good practice level.

Tool III: Flap observation checklist sheet among patient undergoing free tissue transfer surgeries:

It was developed and modified by researcher to monitor postoperative free tissue transfer surgeries complications, which covers the following areas (color, temperature, turgor, capillary refill, dermal bleeding and pin prick test).

It consists of (33) items which covers the following:
1. Color of the flap which includes (4) items.
2. Temperature of the flap which includes (3) items .
3. Turgor of the flap which includes (3) items .
4. Capillary refill of the flap which includes (3)items .
5. Dermal bleeding which includes(4) items: (2) items to assess color of bleeding and (2) items to assess site of bleeding recipient or donor .
6. Pin prick test which includes (3)items
7. Vital signs which include (4) items blood pressure, temperature, pulse, respiration .
8. Laboratory investigations which includes(4) items hematocrit, prothrombin time& concentration, blood sugar, hemoglobin .
9. Intake and output which includes (2) items negative, positive .
10. Occurrence of flap failure which includes (2) items failed or not
11. Flap was observed ¼ hourly for the first 6 hours, ½ hourly for the subsequent 18 hours, hourly for the subsequent(48) hours. Reassess individually according to ongoing clinical needs. This was done every day until the patient discharged from traumatology care units.
12. As regards this tool, the healthy flap was differentiated from unhealthy according to the following table. In which identification of arterial insufficiency and venous congestion will help in early detection of flap failure):

Table 1: Healthy and compromised flap:

Observation	Healthy flap	Arterial Insufficiency	Venous Congestion
Skin Color	Similar to that of donor area	Pale	Purple/ blue
Turgidity	Soft	Spongy, prune-like	Stretched, swollen
Temperature	Warm	Cold	Cold
Capillary Refill	2-3 Seconds	Absent/ Sluggish > 6 Seconds	Brisk < 3 Seconds
Pin-prick test	1:2 drops of blood	No blood	Rapid exit of dark red blood

This table adopted from Hitchinson and Williams, (2003)

Tool IV: Patients assessment sheet for free tissue transfer surgeries:

It was used to assess flap failure that might develop among all patients admitted to reconstructive microsurgical unit until six months after implementation of the teaching protocol. The assessment sheet includes (31) items and covers the following areas:-

- Socio demographic data: patients age, sex, residence, marital status, occupation, educational level, and date of admission. It includes (8) items.
- Flap data covering the following (23) items: Medical diagnosis, site and cause of injury, recipient and donor site, type of tissue used, ischemia time, hours of surgery, intraoperative and postoperative complications related to flap failure. Signs of arterial or venous insufficiency,

and immediate measures to reduce them. The patient is assessed by researcher and nurses by daily flap assessment sheet.

Methods

The study tools and teaching protocol of work were formulated after a review of current and related literature about flap failure and assessment of nurse's knowledge and practice in this regard. The content validity of the tool and teaching protocol was checked, revised by expert professors in fields of medicine and nursing and correction was carried out accordingly.

A pilot study was implemented on five nurses and five patients to test the feasibility, the ability of the tools to elicit the desired and test information, to estimate the time needed to fill out the tools. Analyses of the pilot study revealed that minimal modifications are required. To facilitate the implementation of the teaching protocol about flap failure, researcher prepared the training places, teaching aids and media (pictures, videotapes and handouts). This was followed by arranging for the teaching protocol schedule based on the contents of protocol, number of staff involved, time availability, shifts as well as the resources available.

An official permission to proceed with the proposed study was granted from the head of the Reconstructive Microsurgical and Traumatology Care Units as well as the hospital nursing director. Names of nurses included in the study were obtained from the head nurses of the two selected units (reconstructive microsurgical unit and Traumatology care unit). Nurses and patient were informed of the purpose and nature of the study. The investigator emphasized that the participation is voluntary and confidentiality and anonymity of the subjects will be assured through coding all of data.

At initial interview, the researcher introduces herself to initiate line of communication, explain the nature and purpose of the teaching protocol and fill out the questionnaire sheet. Also she scheduled with them the teaching sessions for both theory and practice and the nurses were divided into small groups, each group contains two to four nurses. Each group of nurses was given the freedom to choose their optimal time for receiving the teaching protocol whenever they have minimal workload.

The teaching protocol has been implemented for nurses in terms of sessions and teaching on the spot during their official working hours. There was a total of nine sessions. These nine sessions were repeated 10 times to each group. Number of nurses in each session ranged between two- four nurses. The duration of each session was an hour, including 15 minutes for discussion and feedback. Each session usually started by a summary of what has been taught during the previous sessions and the objectives of the new topics. Feedback and reinforcement of teaching were performed according to the nurses needs to ensure their understanding. Giving recognition to the interested nurses was emphasized for motivation during the teaching protocol implementation.

An Arabic version of flap observation checklist sheet was used. It was fully explained to nurses (contents and how to apply), then it was distributed to nurses by the researcher immediately after the application of the teaching protocol in order to identify how the nurse uses this sheet for early detection of patients at risk of flap failure. Also the researcher explained the nature and purpose of the teaching protocol to the selected patients who are willing to participate in the study and filled out the patient assessment sheet. Each patient was handed a list of instructions about home care after microsurgery.

It was done to evaluate the effect of implementing the designed teaching protocol on nurse's performance for reduction or prevention of post operative flap failure. Each nurse obtained a copy of the teaching protocol booklet that included all the training contents. Immediately after protocol implementation as well as after 2 months, the nurses' knowledge and practices have been evaluated by the researcher through filling the tools. Also the patients and free flap were assessed for early detection of flap failure using flap observation checklist sheet (¼) hourly for the first (6) hours,(½)hourly for the subsequent (18) hours, hourly for the subsequent (48) hours and then every 4 hours for the next days until the patient was discharged from Traumatology Care Units, as well the researcher filled the patient assessment sheet, The whole period for teaching protocol implementation was 1 year.

An official letter was issued from the Dean of the Faculty of Nursing to the Head of the Reconstructive microsurgical and Traumatology care units as well as the Head of Nursing Service Administration soliciting the necessary approval to conduct the present research. Meetings with nursing supervisors and physicians of these two units to explain the objectives and contents of the teaching protocol and the methods for applying the teaching protocol to gain their cooperation and to allow the release of nurses to attend the teaching protocol during minimal workload activities.

Limitation of the study:
1. Since the researcher was the only data collector, this study did not include patients monitoring for 24 hours. So, it was impossible to be sure if flap observation checklist sheet were properly applied.

2. Investigation findings are limited to one geographical area in Arab Republic of Egypt (Assiut University Hospitals).
3. Limited number of patients. Patients flow was little.
4. As results of small number of nurses working in this unit researcher was obliged to include nurses working with similar patient in other units inside the hospital.
5. Literature and nursing researches in this area were inadequate.

Statistical Design:

Data were analyses using SPSS. The following tests for significance were used, Frequency, Percentage, Means and Standard Deviation. Chi square (with yets correction). Correlation coefficient, ANOVA and t-test for comparison of means. A probability level of 0.05 was adopted as a level of significance for testing the research hypothesis.

3. Results

Frequency distribution of socio demographic characteristics of nurses showed that, the majority of the nurses (63.3%) their age ranged from 20 to 25years (mean: 24.63±2.65); 70% of them were single, living in urban area, and have baccalaureate degree. All nurses (100%) had no in-service training courses related to microsurgery. Their experiences were mostly more than 24 months (56.7) with mean duration of 29.97±23.02 months.

Table (2): showed that, a significant statistical difference between nurse's knowledge in relation to total and subtotal mean knowledge scores with p-value of <0.01 in all items except in postoperative care knowledge items between immediately post protocol and after 2 months.

Table (2): Two by two t-test for the mean knowledge score obtained by nurses Pre-, Immediately post and 2 months after application of the teaching protocol (n=30).

Knowledge	Pre -protocol	Immediately post-protocol
Total: Immediately post-test. 2 months post-test.	37.90** 36.60**	9.70**

** Significant at <0.01   N.S= non significant

Table (3): showed that, a significant statistical difference between nurse's practice in relation to total and subtotal mean practice scores with p-values of <0.01 in all items.

Table (3): Two by two t-test for the mean total and subtotal practice scores obtained by nurses Pre-, Immediately post and 2 months after application of teaching protocol (n=30).

Practice items	Pre-protocol	Immediately post-protocol
Total (Maximum score =112): Immediate post-test 2month post-test	291.26** 66.18**	4.54**

** Significant at <0.01

Table (4): showed that, a positive correlation between nurse's knowledge and practice scores in immediately and 2 months after application of the teaching protocol with p-value <0.01. Thus fourth hypothesis was supported

Table (4): Correlation between nurse's knowledge and practice scores before and after application of the teaching protocol (n=30)

Knowledge	Practice					
	Pre- protocol		Immediately post -protocol		2 months post--protocol	
	r-value	p-value	r-value	p-value	r-value	p-value
Pre-test Immediately post-test 2 months post-test	0.11 0.01 0.07	ns ns ns	0.67 0.41 0.55	** ** **	0.46 0.36 0.35	** ** **

** Significant <0.01   ns= not significant

Table (5): showed that, age was positively correlated with total and subtotal knowledge scores especially during the 2 months post-test. However nurse's experience was found to be positively correlated with total and subtotal knowledge's scores all through the study period.

Frequency distribution of socio demographic characteristics of patients showed that, more than half of the patients (60%) their age ranged between 12 to 36 years with mean of (14.6+8.9). The majority of patients were male, living in rural area, single, have secondary education, and have no work in percentages of (70%, 73.3%, 90%, 46.7%, and 63.3% respectively).

Table (5): Correlation between duration of experiences and age of nurses with total and subtotal knowledge scores obtained pre, immediately post, and 2 months after the application of the protocol (n=30).

Sociodemographic variables / Knowledge items	Age		Duration of experience	
	r-value	p-value	r-value	p-value
Total:				
Pre-test	0.137	ns	0.090	*
Immediately post-test	0.187	ns	0.042	**
2 month post-test	0.360	*	0.052	**

** Significant at <0.01　　* significant at < 0.05
ns= non significant

Table (6): Frequency distribution of the study sample as regards relationship between flap failure and other complications

Other complications	Flap failure	
	X^2	p-value
Hyperthermia	12.22	**
Infection	2.49	ns
Postoperative shivering	3.15	ns
Pain	8.57	**
Venous obstruction	12.71	**
Arterial obstruction	17.01	**

** Significant <0.01　　　ns=not significant

Table (7): showed that, a gradual improvement in flap condition reached to the maximum improvement before discharge. A significant statistical differences was found between normal, venous, and arterial flap during 1st, 2nd, 3rd, and before discharge in relation to color, temperature, and turgor with p-value < (0.01).

Table (7): Frequency distribution of the study sample as regards flap observation in first, second, and third postoperative days as well as before discharge (n=30)

Flap observation	1st day		2nd day		3rd day		Before discharge		X^2 value P-value
	No.	%	No.	%	No.	%	No.	%	
Color:									
Normal (similar to that of donor area)	26	86.7	23	76.7	26	86.7	29	96.7	
Venous (Purple)	1	3.3	6	20	3	10	0	0.0	12.09
Arterial (white)	3	10	1	3.3	1	3.3	1	3.3	*
Temperature:									
Normal (warm)	20	66.7	27	90	29	96.7	29	96.7	
Venous (cold)	5	16.7	2	6.7	0	0.0	0	0.0	17.17
Arterial (cold)	5	16.7	1	3.3	1	3.3	1	3.3	**
Turgor:									
Normal (soft)	20	66.7	26	86.7	28	26.7	29	96.7	
Venous (hard and swollen)	9	30	3	10	1	3.3	0	0.0	16.8
Arterial (spongy)	1	3.3	1	3.3	1	3.3	1	3.3	**
Capillary refill:									
Normal (2:3 second)	29	96.7	26	86.7	29	96.7	29	96.7	
Venous (<3 second)	0	0.0	3	10	0	0.0	0	0.0	9.23
Arterial (>6 second)	1	3.3	1	3.3	1	3.3	1	3.3	ns
Pin prick test:									
Normal (1:3 drops of bright red blood)	30	100	26	86.7	28	26.7	29	96.7	
Venous (rabid exit of dark red blood)	0	0.0	3	10	1	3.3	0	0.0	
Arterial (no bleeding)	0	0.0	1	3.3	1	3.3	1	3.3	7.30 ns

** Significant p <0.01　　　*Significant p<0.05　　　ns=not significant

Table (8) showed that a significant relationship between most of complications and socio demographic characteristics as regards sex, site of injury, cause of injury, and type of transferred tissue.

Venous and arterial obstructions were found to be significantly correlated with ischemia time with p-value <0.05.

Table (8): Relationship between socio demographic characteristics of patients and development of complications (n=30)

Sociodemographic characteristics	Complications											
	Hyperthermia		Infection		Shivering		Pain		Venous obstruction		Arterial obstruction	
	X^2	P-value	X^2	P-value	X^2	P-value	X^2	P-value	X^2	P-value	X^2	P-value
Age	0.4	ns	1.35	ns	0.87	ns	1.82	ns	0.23	ns	0.9	ns
Sex	0.71	ns	5.40	*	4.45	*	15.26	**	2.13	ns	0.44	ns
Residence	0.51	ns	2.06	ns	1.67	ns	0.34	ns	1.21	ns	0.37	ns
Marital status	1.5	ns	0.15	ns	2.16	ns	0.84	ns	2.59	ns	0.51	ns
Education	0.43	ns	1.16	ns	3.4	ns	0.81	ns	2.92	ns	1.78	ns
Occupation	3.4	ns	2.84	ns	0.94	ns	0.16	ns	0.72	ns	0.68	ns
Site of injury	4.45	*	1.22	ns	0.04	ns	5.16	*	8.57	**	1.79	ns
Cause of injury	11.27	**	4.39	*	0.87	ns	8.7	**	0.01	ns	1.18	ns
Type of transferred tissue	16.7	**	1.42	ns	0.71	ns	1.5	ns	0.51	ns	11.01	**
Ischemia time	0.87	ns	0.9	ns	1.04	ns	0.45	ns	6.66	**	17.5	**

**= Significant at 0.01   *= Significant at 0.05   ns=Not significant

4. Discussion:

Microsurgery is surgery that is performed on very small structures of 1 to 5 millimeters, such as blood vessels and nerves, with specialized instruments under a microscope. It is frequently used because of their many advantages such as reliable vascularity, less infection, better postoperative function and wider resection of advanced lesions. Therefore application is increasing in various areas of tissue defects and now more than 100 microsurgical procedures are carried out annually in Assiut University Hospitals. This type of surgery is considered a critical one as the patient is threatened by flap failure especially during the first 48 hours postoperatively (Mark, 2003).

Based on the results of the present study, the majority of the nurses were adults. All of them have no in-service training courses related to microsurgery. More than half of them their experiences were mostly more than 24 months. So it had been concluded that nurses are not properly prepared prior to their graduation and starting to serve patients with free tissue transfer surgeries. Their real experiences were gained while working in reconstructive microsurgical unit only. However the researcher was imagining that there should be a perfect training program designed for a selected group of nurses and other health team

member a head of time to prepare team capable of dealing with such group of patients.

In the same line, Georgiade, et al, (1999) mentioned that a trained nursing staff in microsurgery unit as part of plastic or orthopedic ward is central and necessary for adequate postoperative care. It is necessary to prepare nurses to handle such specialization area of care at the postgraduate level by enrolling in a specially or continuing education program. As well Stroch and Rice, (2005) reinforce on the principles that promote flap success which is a team approach including specialist nursing and high quality of nursing care provided to the patient and the wound. Nahabedian, (2006) and Goldner, and Urbaniak, (1999) documented that, intensive care and reconstructive microsurgical units should be provided by nurses, especially trained in the monitoring vascular viability of the flap as well as early detection of flap failure.

The current study revealed a great lack of knowledge and practices as regards to free tissue transfer surgeries before the application of teaching protocol as all nurses had an unsatisfactory knowledge score levels. This reflects the lack of scientific preparation in these specialized surgeries. This might be related to the fact that, reconstructive microsurgery is recently introduced in Assiut university hospitals as

a new surgical specialty. So it is to be concluded that studied nurses were not properly prepared prior to their working and dealing with such patients. In this respect, Stroch and Rice, (2005) and Kneal and Davis (2005), reported that nurses have a very dominant role in clinical monitoring, observations, clinical responses, and educating other clinicians regarding the postoperative monitoring of free flap.

Moreover, Shell, (1999) and Change, (2006), mentioned that the use of microvascular surgery has placed demands on the perioperative nurse to remain current on perioperative implications of this type of surgery. Nurses must be able to expand their knowledge of this area through ongoing education, journals, and seminars. Consequently, teaching programs for nursing staff constitute an important part. These programs are urgently designed to assess nursing staff in developing and enhancing the skills needed to provide high standards of care to their patients. As well, Billing (1991) and Dunning (1993) agreed that those programs are urgently needed to provide up-to-date knowledge and improve nurse's competency and skills.

After implementation of the teaching protocol, nurses' knowledge score levels regarding free tissue transfer surgeries were significantly improved. This improvement might be related to the fact that all nurses were in young age this age might have good readiness for learning new things as most of them are also single i.e. they might have less responsibilities and more capacity of learning. These results are in agreement with those of Meyer and Elliott (1999) who noted that nurse's knowledge scores were higher among younger and newly graduated nurses who are attending a training program By time, i.e. after 2 months post-test, the percentages of knowledge were slightly reduced as the majority of nurses were having satisfactory and good levels in all items of knowledge. This indicates that the improvement in knowledge was partially lost 2months after implementation of teaching protocol. This result might be explained by the fact that, knowledge retention is usually affected by time. This effect is toward the reduced level of retention.

Broomfield (1996) conducted a research with the intention of testing the retention of certain nursing skills and knowledge of registered nurses. There has been an initial improvement after performing the training program, but there has been a significant decrease in retention of knowledge 10 weeks later (P<0.0001). The findings of his research reflect similar results to previous research works, suggesting that retention of skills and knowledge quickly deteriorates with time if not used or updated regularly. He recommended refresher courses on regular basis.

In this regards, Mehany (1999) and Abd-Alla (2000), found a direct relation between memory loss and length of time that lapses after a certain educational event. Also they reported that nurses who had poor levels of knowledge and/or skills before the exposure to a training program underwent a significant improvement after the implementation of the program.

The current study revealed a great improvement in the practice score levels obtained by nurses after the application of the teaching protocol in all items. This has been concluded by the presence of significant differences between results of pre-tests and post-tests. These significant differences mostly remained two months after the application of the teaching protocol. This finding indicated that skills can be easily improved, especially if linked with their relevant scientific base of knowledge.

In this respect, Sherwood (1996) reported an improvement in nurses' practice after the attendance at continuing nursing education sessions. Research findings indicated that continued nursing education programs increase both knowledge and performance and can also improve attitudes. As well, Bayoumy (1999) and Abd-Alla (2000) documented that the inservice training program has a beneficial effect in improving the nurses' knowledge and skills. They also recommended that educational programs should be organized according to the needs of nurses with continuous evaluation.

In this study the researcher measure nurse's knowledge and practice in different intervals to measure their knowledge retention. Mehany (1999) and Abd-Alla (2000) mentioned that periodic follow up enhances the audience's ability to retain information and improve their skills. As well McCorkel and Grant, (1994) stated that many educational programs use a comparison of the participants pre-test and post-test scores as an indicator for the effectiveness of the program.

As regards incidence of flap failure, the current study found that only 3.3% of patients developed flap failure after application of the teaching protocol as compared to 20% before application of the teaching protocol one year ago. In the same line, a study that was done by Cheung, (1998) reported that the success rate of microvascular free flap surgery was 93.6%. Complete losses of free flaps were found in three patients (one had a radial forearm flap for forehead basal cell carcinoma, one had a transverse rectus abdominis (TRAM) flap for breast cancer, and the third had a lateral arm flap for foot ulceration.

In this respects, Bunche, (2003) reported that, vascular compromise is a frequent complication and ranges from 5% to 26%. Also Stroch and Rice, (2005) stated that in a major flap and reconstruction

surgery, arterial spasm, arterial and venous flow compromise (Thrombosis) and subsequent loss of flap are distinct and high risk.

The current study revealed that 13.3% of studied patients developed an infection after free tissue transfer surgeries. It was found that infection is significantly correlated with the site and cause of injury; in which three patients out of the four who developed infection had severe crush injuries in lower limb. In this regard researchers at the University of Texas Anderson Cancer Center found that patients undergoing free tissue transfer have significantly higher incidence of flap complications such as flap loss and infection (Jansen, 2002). In the same line Green (2000) reported that, deep infection caused flap failure in patients who had severe crush injuries and incomplete wound excision. This endangers flap viability and increase the risk of infection

The present result agrees with Porter, (2004) who reported that, 8-20% of patients undergoing free tissue transfer develop infection. In this respect a study was done on 52 patients with open tibial fractures by (Bunche, 2003) who reported that a seventy-five percent of bone flaps, attempted in patients who eventually achieved soft tissue coverage, failed because of infection.

The current study showed that 10% i.e. three patients only out of thirty developed venous obstruction and 3.3% i.e. one patient out of thirty developed arterial obstruction. Arterial obstruction occurred 18 hours postoperatively, and the patient was returned to operating room for flap salvage but it failed. As regards those patients who developed venous obstruction, the signs and symptoms of venous obstruction appeared in the second postoperative day and no one failed. This might be due to early detection, which helped in early intervention and increased success rate of flap salvage.

In this regards Russell, et al., (2000) and Change, (2006) reported that flap failure is best detected by regular observation of the flap by experienced nursing staff. If there is any doubt the patient must be rapidly returned to theatre and the microvascular anastomosis inspected. Prompt re-exploration will usually salvage an early detected failed flap. As well Nahabedian, (2006) stated that monitoring the free flap during the postoperative phase is critical to ensure flap survival. When recognized early and managed promptly (<6 hours); compromised flaps have a 70% salvage rate when taken back to the operating room. Studies have demonstrated that venous thrombosis alone is more common than either arterial or combined arterial and venous thrombosis. Thrombosis typically occurs within the first two days in 80% of patients. Thus all personnel responsible for flap monitoring must be knowledgeable of the appearance and evaluation of the healthy and compromised flap.

A significant relationship was found between flap failure and other complications as regards hyperthermia, pain, venous obstruction, and arterial obstruction. i.e., other complications are considered as risk factors of flap failure. However the researcher found that the flap failure was due to arterial obstruction.

Regarding flap observation, it was found a gradual improvement in flap condition reached to the maximum improvement before discharge. A significant statistical difference was found between normal, venous, and arterial flap during first, second, third day and before discharge in relation to the color, temperature, and turgor. This means that no abnormal changes were found after the seventh postoperative day. These results are in agreement with those reported by Janezic, et al, (2000) and Storch and Rice, (2005) who reported that the most critical time for flap failure was the first 4 days post operatively. No microvascular complication occurred later than the seventh day.

In the present study only one flap was characterized by white color, cold, spongy, capillary refill more than 6 seconds, and no bleeding with pin prick test. This flap was detected in the 1st day and failed due to arterial obstruction. In the same line Hitchinson and Williams, (2003), Porth, (2000), Woodberry, (2003) Kelly, et al., (2004) and Storch and Rice, (2005), denoted that flap failure occurs primarily as a result of both arterial occlusion and venous congestion. Risk of arterial occlusion increased within 24 hours postoperatively and venous congestion between 24 and 72 hours. Recognition of ischemia is important in preventing subsequent flap necrosis thus flap failure.

The current study showed a significant correlation between the development of flap failure and socio demographic characteristics of patients as regards sex, site of injury, cause of injury, and type of transferred tissue. These results are in agreement with the study of Janezic. et al (2000), they found that, age and sex, site, cause and mechanism of injury, occurrence of thrombi were potential survival factors after free tissue transfer.

There was a significant correlation between the development of venous and arterial obstruction and ischemia time. It was found that the ischemia time was between 2.5 - 3.5 hours in about 60% of patients. In the same line a study was conducted by Nahabedian, (2006), entitled as "Flap, free tissue transfer", which revealed that the flap ischemia time, does not contribute to flap demise if the ischemia time is less than three hours or less than the time for no-reflow to occur.

Janezic. et al (2000) found that the success rate for free flap was 66% and the most frequent cause of failure was thrombosis. Storch and Rice, (2005), found that, regular and objective vascular inspection of the flap by specialist nurses with expertise in flap monitoring and reconstructive surgical wound management are required for the first 48-72 hours. This might necessitate the presence of a specialist nurse to undertake such observations. The nursing care is vital to maintain the survival of the flap, and help in early detection of these factors which potentially contribute to flap failure (Martins and Montero, 2007).

Early diagnosis of flap failure is a precondition for flap salvage. Postoperative monitoring of microvascular transplants is an absolute necessity to further increase the success rate of this procedure. Moreover, the time interval needed for re-establishing vascular flow is the decisive factor for a successful revision. Clinical observation is still the normal standard for free tissue transfer monitoring. Researches cited above pictured the flap failure as an existing profound problem which necessitates an effort and concern to reduce or prevent its occurrence by early detection. In this regards, Futran, et al., (2000) reported that monitoring strategies have been developed to address the issue of early detection of postoperative flap compromise in an effort to permit intervention and flap salvage.

Finally, it can be concluded that, the teaching protocol for nurses working with patients undergoing microvascular free tissue transfer surgeries had achieved its objectives by improving nurses' knowledge and practice about nursing management to reduction or prevention of post operative flap failure. Furthermore, the teaching protocol showed its impact on early reduction or prevention of flap failure. Porth, (2000); and Storch and Rice, (2005), stated that professional nurses have a large role to play in the minimization and prevention of local thrombosis and should be clinically well versed in all aspects of the condition, current strategies to address risk minimization and prevention management and advocates for patient safety.

5. Conclusions:

Based on the result of the present study, it can be concluded that: patient with free tissue transfer surgeries are at high risk for postoperative complications which in turn increase the development of the flap failure. These complications include hyperthermia, pain, infection, venous and arterial obstruction as previously mentioned in the literature and need effective measures to reduction or prevention of post operative flap failure. Nurse's knowledge and practices regarding free tissue transfer surgeries in Reconstructive Microsurgical Unit at Assiut university hospital are inadequate. Nurses are potentially capable to improve their knowledge and practice after exposure to teaching protocol. Application of teaching protocol about care of patients undergoing free transfer surgeries shows a significant improvement in nurses' knowledge and practice. Improving nurses' knowledge and practice can favorable affect the incidence and outcome of flap failure.

Recommendations

Based on results of the present study the following can be recommended:

Continued nursing education and in-service training programs on reconstructive microsurgery should be well organized within Assiut University Hospital and equipped with the necessary educational facilities and materials necessary to upgrade the knowledge and skills of practicing nurses, which will be reflected on better outcome and service for inpatients. Nurses should add to their routine obligations the regular reading of up-to-date references (periodicals, textbooks, etc.). They should always be encouraged to attend scientific meetings and conferences to keep pace with the rapidly growing wealth of knowledge and practice necessary for proper nursing service. Periodic monitoring of nurses knowledge and practice to evaluate the level of nurses. Replication of the study on a larger probability sample acquired from different geographical areas in Egypt to figure out the main aspects of this problems. Newly employed nurses in Reconstructive Microsurgical Unit are required to successfully complete a test of basic knowledge and skills before assuming independent responsibility for patient care. A continuing educations program be planned for and offered on regular basis to nurses in the Reconstructive Microsurgical Unit. Use of flap observation check list sheet as a routine nursing care of patients in Reconstructive Microsurgical Unit and nurses should be adequately trained on how to use it and what to report and when. It is recommended that similar studies should be replicated on longitudinal bases till one year as a minimum time period for follow up. Patients undergoing free tissue transfer surgeries should be exposed to physical therapy practices to avoid/prevent problems that may occur.

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