Effect of Body Mass Index on Accuracy of Doppler Ultrasonographic Detection of Dominant Perforator of Deep Inferior Epigastric Artery Perforator Flap

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ABSTRACT

Objective: The objective of this study is to find the frequency of correct identification of the dominant perforators by pre-operative Doppler ultrasonography in deep inferior epigastric artery perforator flap in relation to increasing body mass index (BMI).

Study Design: Descriptive cross-sectional study

Place and Duration of Study: This study was carried out in Jinnah Burn & Reconstructive Surgery Centre, Lahore from 4th June 2013 to 4th June 2015.

Materials and Methods: A total of 46 patients fulfilling the inclusion criteria were enrolled from Jinnah Burn & Reconstructive Surgery Centre, Lahore. An informed consent was taken for color Doppler ultrasonography, operation and to gather information for study purpose. Pre operative BMI was calculated by dividing weight in kilogram (Kg) by height in meter square (m^2) and placed into two group ; group 1 with BMI <30 (normal to overweight) had 33 patients (71.74%) and group 2 BMI ≥30 (obese), 13 patients (28.26%). Preoperative Doppler USG was done for localization of dominant perforator in periumbilical region of Deep inferior epigastric artery and distance from umbilicus was measured in centimeters (cm). Per operative distance of dominant perforator confirmed and measured in centimeters along the radius of umbilicus.

Results: Forty six patients aged between 32-46 years with mean 39.3±3.5 years were included. In group 1 all 33 (76.7%) had correctly identified dominant perforators, whereas all the 3 (100%) patients whom the per operative perforator location fall out of 1cm range of pre-operative Doppler localization fell in group 2 (obese patients) showing clinically significant p- value 0.004.

Conclusion: It is concluded that Color Doppler USG is a safe and reliable imaging technique but increasing BMI effects the accuracy of pre-operative mapping of dominant perforator of DIEP flap.

Key words: Deep inferior epigastric artery perforator (DIEP) flap, Dominant perforator, Pre-operative Doppler ultrasonography, Body mass index

INTRODUCTION

Breast reconstruction is an integral component of breast cancer treatment. Newer more refined surgical techniques are being evolved, in order to improve the appearance and feel of autologus reconstructed breast with minimal donor site morbidity.[1]

The era of autologous breast reconstruction began with the Transverse Rectus Abdominus Muscle (TRAM) flap. In 1982 Carl Hartrampf for the first time used pedical TRAM flap for autologus breast reconstruction based upon superior epigastric artery.[2] It was in 1973, Taylor and Daniel coined the term "Free Flap" to describe the distant transfer of many island flap by microvascular anastomosis.[3,4] Due to great work done by Ian Taylor on the vascular territory of the flaps , he documented many of the more common free flap still in use today.[5]

Perforator flaps are the new in the evolution of soft-tissue flaps. These flaps allow the transfer of the patient's own skin and fat in a reliable manner, and have minimal donor-site morbidity.[6] So Deep Inferior Epigastric Artery Perforator (DIEP) flap is a technique which is both an evolution and modification of Transverse Rectus Abdominis Muscle (TRAM) flap for breast reconstruction. In 1989 Koshima and Soeda for the first time used the skin and fat of lower abdomen sparing the rectus muscle and used it for reconstruction other than breast.[7] Finally in 1993 Dr Allen and Treece used DIEP flap for autologous breast reconstruction.[8] Blondeel further improved the understanding and

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popularized the use of DIEP flap in autologus breast reconstruction.[9,10]

Deep inferior epigastric artery has a significantly variable vascular anatomy.[11,12] It has two set of branching system lateral branch (dominant in 54%) and medial branch (dominant in 18%). However in 28% of the cases deep inferior epigastric artery has a central course with centrally located perforators.[13] So pre operative imaging has an important role for the assessment of vessels of DIEP flap for microvascular autologous breast reconstruction.

A number of imaging modalities are available starting from simplest to most sophisticated investigation like hand held Doppler, color Doppler duplex ultrasound scanning, traditional angiography, computed tomographic angiography (CTA), magnetic resonance imaging and angiography (MRI/A) for pre operative vascular assessment.[14]

The ideal imaging modality should give valuable information about the course and caliber of perforating vessels, it should be reproducible, inexpensive, and readily available with low radiation dose.[14]

In developed countries sophisticated and invasive investigations e.g. CT Angiography are used for perforator localization and course. Due to limited availability and affordability, an imaging technique i.e. color Doppler ultrasound that is almost as accurate as CT angiography, non invasive, affordable and available all time can be used to achieve the same purpose .This study in Our population will evaluate color Doppler ultrasound for locating dominant perforators based on size, location, intramuscular and subcutaneous course in comparison to BMI that are important for surgery outcome and flap survival.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out Jinnah Burn & Reconstructive Surgery Centre, Lahore within two years from 4th June 2013 to 4th June 2015. A total of 46 patients fulfilling the inclusion criteria were enrolled from Jinnah Burn & Reconstructive Surgery Centre, Lahore. They were divided into two groups; group 1 with BMI <30 (normal to overweight) had 33 patients (71.74%) and group 2, BMI ≥30 (obese) had 13 patients (28.26%). Female patients aged between 20-50 years, undergoing breast reconstruction were included for the study. Patients with diverication of recti, peri and per umbilical hernia on clinical examination or ultrasonography, mid line infraumbilical scar, previous history of abdominoplasty/ liposuction were excluded. An informed consent was taken for color Doppler, operation and to gather information for study purpose. Pre-operative BMI was calculated; weight in kilogram (Kg) divided by height in meter square (m^2) and placed into two groups; group 1 BMI <30 and group 2 BMI >30. Preoperative Doppler USG was done for localization of dominant perforator in periumbilical

region of deep inferior epigastric artery flap and distance from umbilicus was measured in centimeters. Per-operative distance of dominant perforator confirmed and measured in centimeters along the radius of umbilicus and documented as correctly identified or not (Figs. 1-4). The defect was created on chest wall and internal mammary vessels dissected out in the 2nd and 3rd intercostals space for microvascular anastomsis and flap insetting done. Donor site closed primarily and drains placed. Post operatively free flap monitoring and vital monitoring was done for 5 days. Drains were removed on 2-3rd day depending on the outcome. Patient mobilized on 2nd post operative day. First dressing was changed on 5th post-operative day. Uneventful, patients were discharged on 8th post-operative day. Data was recorded and patients were divided in 2 groups. Correct identification of dominant perforator was labeled as per operational definition.

RESULTS

In group 1 all 33 (76.7%) had correctly identified dominant perforators, where as all the 3 (100%) patients whom the per operative perforator location fall out of 1cm range of pre operative Doppler USG localization fell in group 2 obese patient showing clinically significant p-value 0.004.

Table No. 1: Crosstab between BMI & correct identification of dominant perforator

BMI	Correct identification of dominant perforator	
	Yes	No
Normal to overweight (BMI <30)	33	-
Obese (BMI ≥30)	10	3
Using chi square test, p value=0.004 (Significant)		

Figure No. 1: Pre-operative Doppler ultrasonographic marking of perforators
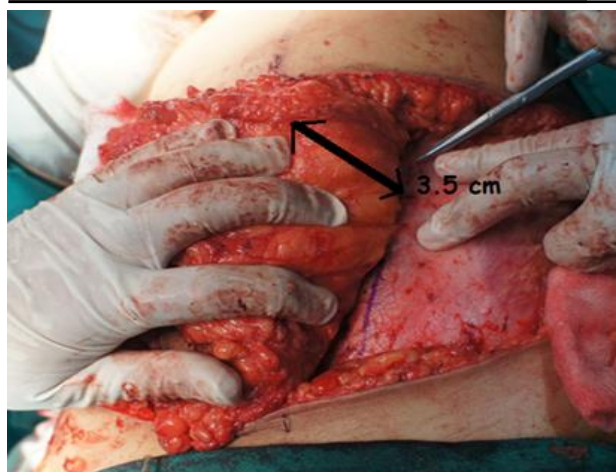
Figure No.2 2: Per-operative localization of dominant perforator

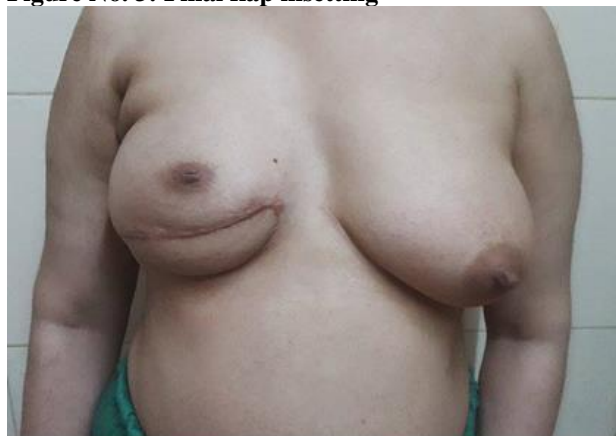**Figure No. 3: Final flap insetting**

Figure No. 4: Three months follow up picture

DISCUSSION

Color Doppler ultrasonography is noninvasive and has no radiation exposure. Its can give valuable information on flow characteristics of perforators and the main vessels. From this, the quality of vessels and their suitability can be assessed. Studies have shown perforators with diameter greater the 0.5 mm can be accurately detected by color Doppler USG with a true-positive rate of more than 90 percent.[15] Thus, several surgeons still choose this method of imaging despite recent advances in computed tomographic angiography and magnetic resonance angiography. It has a small probe, so can show vessels in a small area only.

So, the color Doppler ultrasonography which is readily available and also cost effective, when combined with other conventional techniques i.e. hand held Doppler can give high predictive value. The only drawback of these are they are operator dependant and not reproducible. A study conducted by Seidenstucker et al[16] shows a single perforator identified by both pre-operatively color flow duplex ultrasonography and at the time of intra-operative flap harvest as the dominant perforator was identified in 36 of 46 flaps (78.3%). The study also showed that in 45 of 46 patients (97.8%) the intra-operative perforator chosen at the time of flap harvest was identified as one of the pre-operative perforators marked by duplex ultrasonography.[16] In our study combination of hand held Doppler and color Doppler ultrasonography has shown a high predictive value of correct identification of pre operative and per operative dominant perforator in 43 out of 46 patients (93.48%).Also all the single or multiple perforators in a single row with diameter >1mm, within 6cm radius of umbilicus were included in flap harvest in order to increase the flap perfusion. This shows that combination of conventional handheld Doppler and color Doppler ultrasonography with help of professional expertise can give valuable information on perforator vessels of new perforator flaps with high true predictive value comparable to MDCT or MRA and also higher than any of the conventional techniques used alone.

The musculocutaneous perforators of deep inferior epgastric artery supplying the lower abdominal skin have a variable course through the abdominal fat after they exit from the anterior rectus sheath. So the patients included in the study were divided into two groups based upon the BMI, group 1 with BMI less the 30 and group 2 with BMI more then 30. The data analysis and cross tabulation of correct identification of the dominant perforator with BMI has shown a significant effect of BMI on perforator identification and course through the fat. Out of 46 patient 3 had incorrectly identified dominant perforator location on per operative dissection and all the 3 patients belonged to group 2 (BMI >30). This shows that in obese patients Doppler ultrasonography has decreased sensitivity for correct identification of dominant perforator confirmed with per operative findings.

CONCLUSION

In our target population Color Doppler USG is a safe and reliable imaging technique, with professional expertise present and combined with other conventional methods i.e. hand held Doppler it provides an accurate

pre-operative mapping of dominant perforator of DIEP flap in normal or slightly overweight patients which is comparable to CT angiography, but in Obese patients its sensitivity decreases and one should consider other modalities like MRA for such patients.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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