THE VENAE COMITANTES CLIPPING TEST FOR THE EVALUATION OF THE VENOUS DRAINAGE OF THE RADIAL FOREARM FREE FLAP

SERGIO RAZZANO, M.D.,[1]* LUIGI ESPOSITO, M.D.,[2] and FABRIZIO SCHONAUER, Prof., M.D., Ph.D.[2]

Risks of failure of the radial forearm free flap (FRFF) are mainly related to venous congestion. Two different venous drainage system have been described for the FRFF, but the choice of the best one is still controversial. The superficial systems have a larger diameter and a thicker wall veins which makes them easier to anastomose. The deep system provides most part of the venous outflow if the caliber of the venae comitantes (VCs) is adequate. We propose an intra-operative method to evaluate the FRFF venous drainage: the VCs clipping test. The test has been used in the choice of the vein to anastomose in 12 consecutive patients with oral cavity post oncological defects reconstructed with the FRFF. The cephalic vein was included in the flap; the VCs were individually clipped with small liga-clips and divided with the radial artery still patent. The flap was kept with arterial inflow and superficial venous outflow till the recipient site was ready. If there were no signs of venous stasis, the VCs were kept clipped and the cephalic vein anastomosis was made. If clinical signs of venous stasis were revealed, the largest of the VCs was anastomosed to a vein of adequate caliber in the neck. No signs of flap venous congestion were observed in the postoperative period. No flap necrosis occurred. In this small series of patients the venae comitantes clipping test showed to be an easy, reliable and reproducible method to assess intra-operatively which vein to anastomose. © 2015 Wiley Periodicals, Inc. Microsurgery 00:000–000, 2015.

The radial forearm free flap (FRFF) is still widely studied; it proved to be a safe option to reconstruct head and neck surgical defects, even in elderly patients.[1] Risks of failure of the surgical procedure are mostly related to venous congestion, which still represents the most common complication in head and neck reconstruction using free flaps.[2] The choice of the most appropriate venous drainage of the FRFF is still controversial. Venous drainage of FRFF is provided either by the deep venae comitantes (VCs) with a maximum diameter of 2 mm, or by the superficial veins, with a diameter ranging from 3 to 6 mm.[3] At the level of the cubital fossa the "profunda cubitalis vein[4]" connects the two systems, described also as "perforating vein[5]" or "communicating vein.[6]" The choice of the most reliable venous drainage system to anastomose still remains a problem. Much of the evidence supports the role of the superficial system[7–11] underlining that the use of the superficial network should be favored because of the greater diameter of the veins which makes them easier to anastomose. Some authors[12] suggested that both VCs and the cephalic vein should be anastomosed in a parallel drainage system. Others[13–16] preferred the use of the VCs arguing that the deep system provides the majority of the venous outflow. The purpose of this report is to describe a new intra-operative method for the evaluation of the venous drainage through a simple and intuitive procedure: the VCs clipping test.

PATIENTS AND METHODS

From January 2012 to July 2013, 12 patients with oral cavity post oncological defects were reconstructed with a FRFF at the Department of Plastic, Reconstructive and Aesthetic Surgery of the University Federico II in Naples (Table 1).

Of these 12 cases, seven were male and five were female, average age was 61.7 years old, ranging from 53 to 72 years old; five patients out of 12 were smokers. In all patients the FRFF was used for primary reconstruction of head and neck defects after tumor resection and unilateral or bilateral neck dissection. The head and neck malignancies of the report were staged according to the AJCC-UICC TNM staging system of head and neck cancers.[17] In our case series, 10 malignancies were staged as Stage III tumors and two as Stage IV tumors. FRFF was used in five cases for the reconstruction after SCC of the tongue; in three cases the reconstruction involved part of the tongue and the oral floor. In three cases, FRFF was used to reconstruct the oral floor; in only one case it was used for an SCC of the inner cheek.

Technique for the Evaluation of the Venous Drainage

All the procedures were performed with a two team approach and all flaps were raised by the senior surgeon (F.S.). The vascular pedicle was easily identified using an hand held Doppler probe and marked.[18] The FRFF was harvested in a supra-fascial fashion based on the

[1]Department of Plastic, Reconstructive and Aesthetic Surgery Piazza Miraglia, Second University of Naples, Naples, Italy

[2]Unit of Plastic, Reconstructive and Aesthetic Surgery, Federico II University, via S.Pansini 5, Naples, Italy

*Correspondence to: S. Razzano, M.D., Department of Plastic, Reconstructive and Aesthetic Surgery Piazza Miraglia, Second University of Naples, Naples 80138, Italy. E-mail: razzanosergio@gmail.com

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Table 1. Main Patient's Characteristics, Variables, and Outcomes

Pati-ent	Sex	Age (years Old)	"Type" of lesion/Stage	Lymph node dissec-tion	Size of flap (cm)	VCs clipping time (min)	Venous pedicle after VCs clipping test	Ischaemia time (min)	Pre-transfer venous congestion	Recipient vein	Flap survi-val	Complications	Length of follow-up (months)	Final outcomes: swallowing	Final outcomes: speech intellegibility score
1	F	58	SCC tongue/III	YES	5 × 4	74	cephalic vein	55	NO	Facial	100%	None	12	Normal diet	8/10
2	M	62	SCC tongue/III	YES	6 × 5	80	cephalic vein	60	NO	TLF trunk	100%	None	18	Normal diet	8/10
3	M	67	SCC oral floor/IV	YES bilateral	7 × 6	120	cephalic vein	75	NO	TLF trunk	100%	None	24	Normal diet	9/10
4	M	60	SCC inner cheek/ III	YES	6 × 4	72	cephalic vein	58	NO	TLF trunk	100%	None	30	Normal diet	9/10
5	F	55	SCC oral floor/tongue/III	YES bilateral	6 × 5	112	VC	70	YES	External jugular	100%	None	24	Normal diet	9/10
6	F	70	SCC tongue/III	YES	7 × 4	85	cephalic vein	68	NO	TLF trunk	100%	None	18	Normal diet	7/10
7	M	64	SCC lower tongue + oral floor sx/III	YES	6 × 5	80	cephalic vein	54	NO	TLF trunk	100%	None	30	Normal diet	8/10
8	M	60	SCC lower tongue + oral floor dx/III	YES	7 × 6	112	cephalic vein	72	NO	TLF trunk	100%	Fistula	24	Normal diet	9/10
9	M	62	SCC oral floor/III	YES	4 × 5	75	VC	50	YES	TLF trunk	100%	None	18	Normal diet	7/10
10	F	58	SCC oral floor/IV	YES bilateral	7 × 6	105	cephalic vein	65	NO	Facial	100%	None	24	Normal diet	9/10
11	F	72	SCC tongue/III	YES	4 × 3	70	cephalic vein	53	NO	Facial	100%	None	30	Normal diet	7/10
12	M	53	SCC tongue/III	YES	6 × 5	92	cephalic vein	68	NO	TLF trunk	100%	None	18	Normal diet	8/10
1	F	58	SCC tongue/III	YES	5 × 4	74	cephalic vein	55	NO	Facial	100%	None	12	Normal diet	8/10
2	M	62	SCC tongue/III	YES	6 × 5	80	cephalic vein	60	NO	TLF trunk	100%	None	18	Normal diet	8/10
3	M	67	SCC oral floor/IV	YES bilateral	7 × 6	120	cephalic vein	75	NO	TLF trunk	100%	None	24	Normal diet	9/10
4	M	60	SCC inner cheek/ III	YES	6 × 4	72	cephalic vein	58	NO	TLF trunk	100%	None	30	Normal diet	9/10
5	F	55	SCC oral floor/tongue/III	YES bilateral	6 × 5	112	VC	70	YES	External jugular	100%	None	24	Normal diet	9/10
6	F	70	SCC tongue/III	YES	7 × 4	85	cephalic vein	68	NO	TLF trunk	100%	None	18	Normal diet	7/10
7	M	64	SCC lower tongue + oral floor sx/III	YES	6 × 5	80	cephalic vein	54	NO	TLF trunk	100%	None	30	Normal diet	8/10
8	M	60	SCC lower tongue + oral floor dx/III	YES	7 × 6	112	cephalic vein	72	NO	TLF trunk	100%	Fistula	24	Normal diet	9/10
9	M	62	SCC oral floor/III	YES	4 × 5	75	VC	50	YES	TLF trunk	100%	None	18	Normal diet	7/10
10	F	58	SCC oral floor/IV	YES bilateral	7 × 6	105	cephalic vein	65	NO	Facial	100%	None	24	Normal diet	9/10
11	F	72	SCC tongue/III	YES	4 × 3	70	cephalic vein	53	NO	Facial	100%	None	30	Normal diet	7/10
12	M	53	SCC tongue/III	YES	6 × 5	92	cephalic vein	68	NO	TLF trunk	100%	None	18	Normal diet	8/10

Legend - TLF trunk: Tireolinguofacial venous trunk.

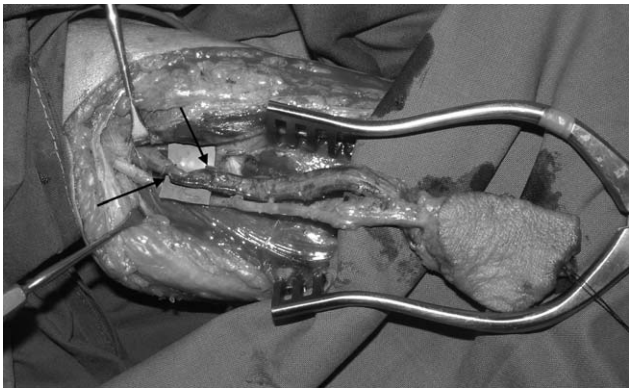

Figure 1. FRFF raised, black arrows showing the clipped VCs. The cephalic vein is retaining venous outflow of the flap while the test is performed.

technique described in the literature. The cephalic vein was included in the flap. The evaluation of the venous drainage of the flap was made when the recipient site was ready, just prior to the complete flap pedicle division. After the flap was completely dissected, the two VCs were individually clipped with small liga-clips and divided with the radial artery still patent (Fig. 1). The FRFF was then re-perfused by releasing the tourniquet, the flap was kept with arterial inflow and the cephalic vein only retained venous outflow. If there were no signs of venous stasis, the VCs were kept clipped and the cephalic vein was used as the venous pedicle of the flap for anastomosis. If clinical signs of venous stasis were revealed, decision was made to exclude the cephalic vein and the largest of the VCs was anastomosed to a vein of adequate caliber in the neck. Arterial anastomosis and flap inset completed the procedure.

RESULTS

Flap size ranged from 4 × 3 cm to 7 × 6 cm. In eight cases a unilateral and in four cases a bilateral modified radical neck dissection was performed. The time for testing the cephalic vein drainage at donor site ranged between 70 minutes and 120 minutes, with a mean time of 89.75 minutes. The mean flap ischemia time, between complete arterial and venous pedicle division and anastomosis, was 62.33 minutes ranging from 50 minutes to 75 minutes. In two flaps signs of venous congestion were noticed and the largest vena comitante was chosen as the only vessel to be anastomosed. No signs of venous congestion of the flap were observed during the first post operative week in any of the cases. No flap necrosis occurred. No major complications were observed. Among minor complications a fistula in the posterior part of the oral cavity occurred in the post operative period, but the complication resolved spontaneously at day 18. Mean follow up was of 18 months ranging from 12 to 24 months. Final outcomes showed a mean speech intelligibility after surgery of 7, 6 out of 10. All the patients after 12 months were on a to a normal diet regime proving a good function of swallowing (Table 1).

DISCUSSION

FRFF is still a valid option for head and neck reconstructions and it is suitable for the most recent three-dimensional shaping techniques.[19] The problem of single versus dual venous drainage system has been well discussed in the literature, not only for FRFF. Whilst no significant difference between single versus dual anastomosis has been shown for free fibula osteocutaneous flap reconstructions,[20] in the anterolateral thigh free flaps, dual venous anastomosis increased the flap's vascular stability and showed a minor percentage of flaps with vascular insufficiency.[21]

The debate on which venous system assures the best venous drainage in FRFF is controversial. *Liu Y* et al.[10] analyzed the incidence of flap complications and flap survival rate of single versus dual venous drainage system of the FRFF. Their results showed that dual anastomosis did not reveal any statistical reduction of the venous complications, concluding that additional anastomosis decreases venous outflow within the flap and adds time to the procedure. Therefore, they preferred the anastomosis of the cephalic vein because of its larger caliber and thicker wall compared to VCs. They suggested, if needed, an additional anastomosis of the deep system as a lifeboat. Futran and Stack[11] in 1996 published a meta-analysis to compare the venous drainage of the anastomosed cephalic vein against a double drainage and the impact on the survival of the flap. They concluded that a single venous anastomosis using a subcutaneous vein provides an adequate drainage reducing operative time without any negative impact on morbidity. Moreover, the anastomosis of both drainage systems reduces the venous pressure, creating a low flow state increasing the risk of venous thrombosis. Some authors[12] suggested that the VCs and the cephalic vein should be anastomosed independently on two distinct venous systems (internal and external jugular) assuring two separate and parallel drainage system. Flow studies ensured that the VCs were the dominant drainage system if they had an adequate caliber.[13] Recently Selber et al.[14] compared complications between the superficial and deep venous drainage systems of the FRFF among 370 consecutive flaps. Their results showed that the venous complication rate was higher in the group with dual venous drainage. They used a linear measure parameter in the choice of which system to anastomose. They observed that if the VCs were 1 mm or greater in diameter at wrist site, proximally they would have been of an adequate caliber for venous drainage without the

need to include the cephalic vein in the flap. Ichinose and Tahara[15] preferred the use of just the VCs; in fact flow-volume studies showed that the VCs had a volume of blood drainage per unit time doubled compared with the one of the cephalic vein, as a consequence the larger caliber of the superficial veins did not reflect a better venous drainage. The temporary exclusion of the VCs allowed us to ascertain if the superficial system was reliable. This test bypassed the anatomical variability, the doubts on the reliability and on the dominance of the superficial or the deep venous system. Our test was based on the assumption that VCs were mainly draining from the deep tissues. Clamping VCs meant forcing the distal skin island to be drained just by the superficial system; the flow was redirected into the larger vein. While this happened in the majority of cases, offering us the opportunity to anastomose a larger venous vessel, it did not always occur. Considering the reversibility of the VCs clipping test, when venous stasis signs were revealed, we still had the possibility to choose one of the the VCs for venous anastomosis. This test has made it possible to assess intra-operatively the efficacy of the cephalic vein as the unique vein to anastomose. However there are limitations in this report which can be related to a small case series and to a lack of case comparison.

CONCLUSION

The VCs clipping test of the could be useful to assess the reliability of the dominant venous system in each single patient, providing an indication in the choice of which vein to anastomose. With the limits of a short case series, this simple test showed to be a safe, easy, reproducible and reversible procedure; it is an helpful tool in the intra-operative decision making process for the evaluation of the venous drainage of the free radial forearm flap. This technique should be evaluated by a large series of cases and comparison studies.

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