BLOOD FLOW TO PALATAL MUCOSAL AND SKIN GRAFTS IN MANDIBULAR LABIAL VESTIBULOPLASTY MEASURED BY ^{133}XE CLEARANCE TECHNIQUE

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SUMMARY: Blood flow to anterior alveolar and platal mucosa in 7 patients and blood flow to anterior alveolar mucosa and skin of upper arm in 7 other patients were measured by intramucosal and intradermal (for skin) injections of ^{133}Xe. Later mandibular vestibuloplasty with mucosal grafts in the first and with skin grafts in the second group was performed. During the postoperative period, the patients were followed by clinical observation, and by blood flow measurements for 6 weeks and 1 month respectively. ^{133}Xe clearance was measured on the 7th and 30th days, postoperatively. In normal subjects, the mean blood flows to alveolar and palatal mucosas were 49.2 ± 5.3 and 26.3 ± 3.6, respectively and to skin was 6.57 ± 0.88 ml/100 g/min. Mean blood flow to mucosal graft was 34.7 ± 5.4 and 37.9 ± 3.9 ml/100g/min on 7th and 30th days after the operation, respectively. The means of blood flow to skin grafts were 48.7 ± 5.1 and 39.6 ± 3.8 ml/100g/min on 7th and 30th days after the operation, respectively. These results were in agreement with clinical observations.

Key Words: Mucosal and skin grafts, blood flow, ^{133}Xe clearance.

INTRODUCTION

Mucosal (palatal and buccal) and skin grafts have been commonly used in vestibuloplasty (7, 8, 14, 18). The survival of graft depends on rapid revascularization and protection of graft vitality (3, 12, 19, 23). Therefore, investigation of blood flow to grafts is crucial. Since the introduction of the method by Kety (10), measurement of blood flow by inert gases such as ^{133}Xe or ^{85}Kr have been applied to a variety of tissues and organs. ^{133}Xe is the most widely used inert gas owing to its physical characteristics ($T_{1/2}$: 5.27 days, $E\gamma$: 81 keV). The ^{133}Xe clearance technique is simple rapid and quantitative. It can be repeated at short intervals of time due to a short biological half-life of ^{133}Xe (2). This technique was used to measure the blood flow to various oral tissues in dogs (9, 11, 20) and to skin grafts in rats and rabbits (5,6,13). Measurement of blood flow to mucosal graft in vestibuloplasty in man was reported by Basa *et al.* in 1987 (2). So far, there has been only one report about the investigation of blood flow in deltapectoral flaps in man (21).

Although blood flow investigations by plethysmographic and rheographic techniques have been performed apart from ^{133}Xe clearance method, these techniques give qualitative results and have some difficulties in clinical applications (1, 15, 22).

In this study, blood flow to normal mucosa (alveolar and palatal) and skin and to mucosal and skin grafts was measured in man by ^{133}Xe clearance technique. The purpose of the study was to compare the blood flow to mucosal and skin grafts and to follow the recovery of graft in mandibular labial vestibuloplasty.

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MATERIALS AND METHODS

Clinical Material

This study was performed in 14 patients referred from Department of prosthetic dentistry for vestibuloplasty. The number, age and sex of the patients are summarized in Table 1. The following investigations were performed in all patients: 1. History, 2. Physical examination, 3. Oral examination, 4. Haematocrit determination, and 5. Making acrylic splint.

The following criteria were applied in the selection of patients for this study: 1. No major systemic health problem, 2. No infection, tumor or other lesion in oral region, 3. Palatal mucosa suitable for taking grafts, and 4. The subjects cooperative for this study. The test was fully explained to the patients and their consent was obtained.

Surgical Methods

Sanders and Starshak's modified technique (16) for vestibuloplasty was used in all patients. Patients were not premedicated. Oral cavity was cleansed with 3% H_2O_2. Faces of the patients were cleaned with 0.001% benzylammonium chloride (zephiran). Regional anesthesia was provided by injection of Ultracain Forte. Muscle attachments and submucosal tissues were dissected and the periosteum was exposed. 0.5 cm high bone surface was left at the bottom for muscle attachments. Mucosal flap was sutured to the periosteum of the mandible with 3-0 vicryl sutures. Receptive area was covered with a 0.9% NaCl absorbed sponge. Palatal donor sites were anesthetized. Oxidized cellulose was applied to the donor sites. Donor sites and the grafts were examined 2, 4, 5, 7, 10, 15, 20 and 25 days after the operation and clinical observations were noted. The patients were asked if they had any pain or loss of sensation. All splints were removed on the 7th day after the operation.

Recording of clearance curves

^{133}Xe (10mCl/10ml saline) obtained from Amersham (England) was used for blood flow measurements. The clearance of ^{133}Xe from the injection site was recorded by a gamma camera (Toshiba digital camera 501 GCA, 501 S) with a dynamic study. Time constants were 1 and 2 s for mucosa and skin, respectively. The recording continued 2 and 6 min for mucosa and skin, respectively. ^{133}Xe was injected to the patients preoperatively on 2nd and postoperatively on 7th and 30th days. The sites of injections were midline region of mandibular vestibule, center of palatal donor site and skin over triceps muscle. ^{133}Xe was injected by the use of tuberculin syringes and 27 gauge needles placed 3-4 mm deep in mucosal tissue or skin parallel to the surface. For each clearance curve, 25-100μCi ^{133}Xe dissolved in 0.1-0.2 ml was injected.

Table 1: The number, sex and age of subjects used in this study.

No of subjects	Sex		Age range (years)	Mean age (years)
	M	F		
14	9	5	34-60	51.1

Calculation of blood flow

The following formula was used for the calculation of blood flow: BF (ml/100g/min) = 100 λ k

λ is the partition coefficient of ^{133}Xe between the mucosal tissue or skin an whole blood and is calculated according to the previous reports (2,4,15). Since λ is a function of haematocrit, haematocrit was determined in each subject and λ was calculated accordingly. k is the clearance rate constant and is calculated using the relation ($k=0.693/T_{1/2}$). The half-life ($T_{1/2}$) of ^{133}Xe clearance in min was obtained from the clearance curves.

Statistical analysis

The results of blood flow measurements were evaluated on computer. The means and standard deviations in each group were calculated and statistical significance between groups were determined by Student's t-test.

RESULTS

Blood flow to alveolar mucosa varied from 15.5 to 89.4 ml/100g/min and the mean value was 49.2 ± 5.3 ml/100g/min. Blood flow to palatal mucosa ranged from 14.3 to 33.2 ml/100g/min and the mean value was 26.0 ± 3.6 ml/100 g/min. Blood flow to the skin had a range of 5.3

Table 2: Blood flow to normal alveolar and palatal mucosa, normal skin and to palatal mucosal and skin grafts.

No. Groups				Blood flow (ml/100g/min) mean ±SD
I	Preoperative	Normal alveolar mucosa		49.2 ± 5.3
II		Normal palatal mucosa		26.0 ± 3.6
III		Normal skin		6.57 ± 0.88
IV	Postoperative	Palatal mucosal grafts:	7. day	34.7 ± 5.4
V			30. day	37.9 ± 3.9
VI		Skin graft:	7. day	48.7 ± 5.1
VII			30. day	39.6 ± 3.8

Table 3: Statistical comparison of groups.

Groups compared	t	p
I-II	3.26	p<0.05*
I-III	8.98	p<0.05*
I-IV	2.38	p>0.05
I-V	1.36	p>0.05
I-VI	0.06	p>0.05
I-VII	1.39	p>0.05
II-III	5.80	p<0.05*
II-IV	1.31	p>0.05
II-V	3.00	p<0.05*
II-VI	3.29	p<0.05*
II-VII	2.51	p>0.05
III-IV	5.36	p<0.05*
III-V	7.34	p<0.05*
III-VI	7.29	p<0.05*
III-VII	7.54	p<0.05*
IV-V	0.38	p>0.05
IV-VI	1.46	p>0.05
IV-VII	0.69	p>0.05
V-VI	2.73	p<0.05*
V-VII	0.34	p>0.05
VI-VII	2.29	p>0.05

* Significant.

to 14.3 ml/100g/min with a mean value of 6.57 ± 0.88 ml/100g/min. Mean values for blood flow to palatal mucosal and skin grafts on 7th day after the operation were 34.7 ± 5.4 and 48.7 ± 5.1 ml/100g/min, respectively. There is a parallelism between blood flow values for skin and alveolar mucosal grafts. But, values for skin grafts on 7th day were higher than preoperative values. Blood flow to palatal mucosa on 30th day after the operation was 37.9 ± 3.9 ml/100g/min which is just below the normal value. Blood flow to skin grafts on 30th day after the operation was 39.6 ± 3.8 ml/100g/min which is higher than the normal value (Table 2).

Statistical comparisons between the groups are summarized in Table 3. Splints were removed at the end of the first week in all patients. Mucosal grafts had pale pink appearance and skin grafts were mostly white. Oedema was minimal or none. Junction area of mucosa and graft completely recovered at the end of the first month. In patients with mucosal grafts, mucosa-mucosal junction showed continuity. In patients with skin grafts, junction area of mucosa and skin showed scar tissue and there was a colour discrimination between the two tissues. In all patients with mucosal and skin grafts, graft was thightly adherent to the periosteum. In patients with mucosal graft, the donor sites had complete healing without scar, but donor sites were bright red coloured in patients with skin grafts at the end of the first month.

11 out of 14 patients had bearable pain in the first two days after the operation, and none of the patients had mental nerve palsy.

DISCUSSION

There are few studies about quantitative measurements of mucosal and skin blood flow. Most of the previous studies are confined to experimental animals. The only study about the measurement of blood flow to oral mucosa in man was reported by Basa *et al.* (2) who used palatal mucosal grafts in mandibular labial vestibuloplasty and measured blood flow to the grafts by ^{133}Xe clearance technique. In that study, blood flow values for normal alveolar and palatal mucosa were 53.2 ± 12.9 and 58.3 ± 3.5 ml/100g/min, respectively. These values are higher than our figures. Blood flow to palatal mucosal grafts was 46.2 ± 16.9 ml/100g/min 4 weeks after the operation. Our results are in agreement with the results of Basa *et al.* There is no other study about the measurement of blood flow to skin grafts in man in order to compare our results. Our results indicated that skin grafts are compatible in vestibuloplasty. The blood flow to normal skin was 6.57 ± 0.88 ml/100g/min before the operation, which was significantly lower than both alveolar and palatal blood flows ($p < 0.05$). But it reached the levels of normal alveolar mucosa on the 7th day (48.7 ± 5.1 ml/100g/min) and 30th day (39.6 ± 3.8 ml/100 g/min) after operation which were significantly higher than the original value ($p < 0.05$).

Aust *et al.* (1) measured blood flow to the mucosa of maxillary sinus by the use of plethysmographic and ^{133}Xe clearance techniques. Blood flows were 88 and 93 ml/100g/min, respectively. Blood flow to nasal mucosa in man measured by Özdem and Ercan (15) was 32.8 ± 2.7 ml/100g/min by ^{133}Xe clearance technique. Blood flow to alveolar mucosa measured in dogs by Hock *et al.* (9) was 0.48 ml/g/min by ^{133}Xe clearance technique. Blood flow to submucosal tissue in dogs measured by Trapp *et al.* (20) was 50 ml/100 g/min which is close to that in man. Squier

and Nanny (17) measured blood flow to 15 different parts of oral mucosa in rhesus monkeys by the use of radiolabelled microspheres. They obtained a value of 12.88 ml/100g/min for alveolar mucosa, which is lower than our figure of 49.2 $\pm$ 5.3 ml/100g/min in man.

Our blood flow results and clinical observations showed that complete recovery of graft occurred in 1-4 weeks after the operation, ^{133}Xe injection for blood flow studies did not slow the recovery of the graft. As a result, blood flow measurements by intra-mucosal and intradermal injections of ^{133}Xe is a proper method that does not change the physiological conditions and can be safely used in man.

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