Subcutaneous Blood Flow in Early Male Pattern Baldness

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The subcutaneous blood flow (SBF) was measured by the ^{133}Xe washout method in the scalp of 14 patients with early male pattern baldness. Control experiments were performed in 14 normal haired men matched for age.

The SBF in the scalp of the normal individuals was about 10 times higher than previously reported SBF values in other anatomical regions. In patients with early male pattern baldness, SBF was 2.6 times lower than the values found in the normal individuals (13.7 ± 9.6 vs 35.7 ± 10.5 ml/100 g/min^{-1}). This difference was statistically significant ($p \ll 0.001$). A reduced nutritive blood flow to the hair follicles might be a significant event in the pathogenesis of early male pattern baldness. *J Invest Dermatol 92:725–726, 1989*

One of the first clinical signs of a reduced peripheral blood flow is the loss of hair. It has been hypothesized that a reduced blood flow in the scalp might contribute to or cause hair loss. The blood supply to the scalp resembles that of skin elsewhere on the body originating from the subcutaneous tissue. The hair follicles are situated in the lower part of the dermis, except in the scalp where the hair follicles are found in the upper part of the subcutaneous tissue. The lower third of the hair follicles is enveloped by a rich vascular plexus composed of long, more or less parallel vessels connected by cross-shunts. These parallel vessels are assumed to be terminal arterioles and are directly connected to the subcutaneous plexus [1,2].

Measurements of the nutritive blood flow to the scalp hair should therefore be performed in the subcutaneous tissue. Measurements of the subcutaneous blood flow in the scalp of patients with early male pattern baldness have not previously been published and are of theoretical and practical interest.

In the present study the ^{133}Xe washout method was used to measure the subcutaneous blood flow in patients with early male pattern baldness. The results clearly showed a reduced SBF in patients with early male pattern baldness.

MATERIALS AND METHODS

Patients 14 male patients healthly patients with early male pattern baldness were examined. They were selected according to the Hamilton scale of male pattern baldness [3]. Only patients with type III vertex or the type IV balding pattern were included in the study (Table I). All the patients were at rest for 1 h prior to measurements. None of the patients had received any local treatment or any vasoactive drugs prior to the study. All measurements were performed at constant room temperature, 21–22°C. Smoking was not allowed 2 h before the experiments.

Control experiments were performed on 14 healthy, normal-haired male individuals matched for age. The ages of the patients and the normal individuals are shown in Table I.

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Methods The subcutaneous blood flow was measured by the local ^{133}Xe washout method. The ^{133}Xe washout method was recently reviewed [4]. Five pilot studies showed that atraumatic epicutaneous labeling of the subcutaneous scalp tissue was impossible due to a very high cutaneous tracer washout. 100 μCi (i.e., 0.01–0.02 ml ^{133}Xe dissolved in isotonic saline) of the tracer was therefore injected subcutaneously into the scalp over the vertex. All measurements were performed with the patients in the supine position. The site of measurement in bald subjects was hairless.

A wide angle NAI(T1) scintillation detector was placed 10 cm over the radioactive field. Pulses were fed into a gamma spectrometer with the window set around the 81 KeV photopeak of ^{133}Xe. The activity was accumulated and recorded over 20-sec periods. The washout rate constant (k) was calculated from the monoexponential washout 60–80 min after the injection, because the injection trauma, which induces hyperemia, can last for 30–40 min in subcutaneous tissue [5]. The subcutaneous blood flow (SBF) was calculated from the Kety equation: $SBF = k/\lambda/100$ (ml/100 g/min^{-1}), where $\lambda = 10$ ml/g^{-1} denotes the tissue-to-blood partition coefficient for ^{133}Xe in the subcutaneous tissue [6].

Wilcoxon's rank sum test and linear regression with the least squares' method were used to analyze the data.

RESULTS

SBF of the vertex scalp was significantly less in bald subjects than in normals (mean 13.6 ml/100 g/min compared to 35.7; $p < 0.001$) (Table I).

DISCUSSION

The results of the present study are in accordance with our previous reports of high SBF in the scalp of normal individuals and in patients with alopecia areata [7]. The SBF was about 10 times higher than SBF found in other anatomical regions.

The inability to use the epicutaneous labeling technique of the subcutaneous tissue in both patients and normal individuals indicates a very high cutaneous scalp blood flow, which is also in accordance with our previous findings [7].

In the calculations of the SBF, a tissue-to-blood partition coefficient of 10 ml/g^{-1} was used [6]. It is possible that the relative content of the lipid in the subcutaneous scalp tissue is reduced compared with the normal subcutaneous scalp tissue. This would influ-

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Table I. Subcutaneous Blood Flow (SBF, ml/100 g/min^{-1}) in the Scalp of Patients with Early Male Pattern Baldness and Normal Individuals

	Patients				Normal Individuals		
	Age (years)	Hamilton Balding Type	SBF + 1 SD		Age (years)	SBF + 1 SD	
	26	IV	10.0	0.5	36	33.3	0.3
	35	III	32.8	0.8	38	44.3	1.1
	33	IV	5.3	0.5	29	61.0	2.4
	36	IV	24.9	0.4	24	35.5	0.8
	23	IV	1.4	0.3	24	27.4	0.2
	28	IV	16.7	0.5	31	36.3	1.0
	21	III	26.9	0.4	46	26.1	0.9
	24	IV	15.6	0.5	36	34.9	0.7
	35	IV	11.3	0.5	39	41.3	0.3
	39	III	8.5	0.5	21	21.3	0.4
	32	III	2.7	0.8	28	27.5	0.7
	25	IV	11.2	0.4	24	25.1	0.4
	29	IV	10.8	0.4	18	46.6	0.7
	43	IV	10.7	0.3	35	39.5	1.0
Mean	31		13.6		31	35.7	
+1 SD	7		9.2		8	10.5	
p				$\ll 0.001$			

ence the tissue-to-blood partition coefficient and hence the calculation of the SBF. However, a reduction of the relative content of lipid in the subcutaneous tissue would only lead to an overestimation of the SBF in the patients compared to the normal individuals. It might, therefore, be concluded that the difference in the washout rate constants between the patients and the normal individuals reflects differences in the SBF.

Another explanation of a reduced SBF might be a decreased skin temperature in the bald skin area. However, changes in the skin temperature by 1°C would only account for a 9% reduction in the subcutaneous blood flow [8]. This makes it highly unlikely that the reduced SBF found in the patients should be due to a reduced skin temperature. Furthermore, a few control measurements of the skin temperature in patients with early male pattern baldness and in normal individuals revealed no significant differences in the skin temperatures.

Growth and regrowth of the hair in the scalp depends upon a sufficient nutritive blood supply to the hair follicles. The significantly reduced SBF in the scalp of patients with early male pattern baldness, as found in this study, might explain the loss of hair and the inability to regrow hair. However, we cannot conclude whether the reduced SBF is primary, secondary, or irrelevant for the etiology of early male pattern baldness from the present study.

Recently, minoxidil, a potent vasodilator has been shown to stimulate the cutaneous blood flow in human balding scalps [9]. Using Laser Doppler Velocimetry technique the investigators assumed that blood flow in the upper layers of the cutaneous tissue was representative of that in the subcutaneous tissue. The results of the present study have indicated that the cutaneous blood flow in the scalp is very high because of the fast washout of the tracer from the cutaneous tissue following epicutaneous tracer labeling. A high cutaneous scalp blood flow might explain the relatively short duration of topical applied minoxidil.

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