Thermographic follow up of medical treatment in extracerebral carotid insufficiency

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SUMMARY. Facial thermography can he used for three purposes. (1) Identification of vascular lesions in the extracranial carotid system. In 49 patients the thermographic false negatives were 9.1% and the thermographic false positives were 15.8%. Telethermography can thus he valid for screening before angiography. (2) Follow-up evaluation of medical treatment. (3) Appraisal of the efficacy of the drugs employed.

Key words: thermography; carotid insufficiency; medical treatment results.

A) Introduction

The object of this work is to examine the possibilities of employment, and the value of the information obtained, of facial telethermography (f.t.t.) in the study of cerebrovascular disease. F.t.t. can be usefully used to identify the haemodynamic alterations resulting from a cerebrovascular lesion, and to follow the developments of the lesion, both spontaneous and as a result of pharmacological and/or surgical treatment. F.t.t., absolutely bloodless, easy and quick to perform, has the advantage of possible repetition whenever the course of the illness requires it.

The normal facial telethermographic picture shows hair, eyebrows and eyes cold, end of nose and cheeks usually cold, forehead and perioral region warm. The thermic behaviour is pratically symmetric. There are no differences between the two parts of the face [2,5,6].

In the occlusion or serious stenosis of the internal carotid artery, the blood coming from the external carotid artery reaches once more the carotid syphon owing to the connections between ophtalmic artery, dorsal artery of the nose, infraorbital artery and supraorbital artery. The vascular supply of the frontal region depends on the frontal supraorbital artery, end-branch of the ophtalmic artery (Fig. 1). As the ophtalmic artery is used to send blood once more into the syphon, reduction or absence of the flow in the frontal supraorbital artery occurs, and this translates thermographically into a cold supraorbital triangular area.

The angiography (Fig. 2) shows the occlusion of the internal carotid at its origin and the hypertrophy of the facial and internal jaw arteries. Along the course of the infraorbital artery and of the dorsal artery of the nose, one can see perfectly the countercurrent flow once more into the ophtalmic artery as far as the syphon. The supraorbital artery is not visualized and this explains the hypothermia of the skin of this area. The superficial temporal artery is also hypertrophic in order to supply the vascular network of the fronto-supraorbital skin.

For thermographic purposes, temperature differences higher than 1°C are considered; lower thermal gradients have only been considered as a suspicious indication.

The frontal supraorbital (f.s.0.) region is the most important point of reference, but

Fig. 1. Outline of the vascularity of the supraorbital region. The dorsal artcry of the nose, the supraorbital artery and the frontal branch of the superficial temporal artery are evident.

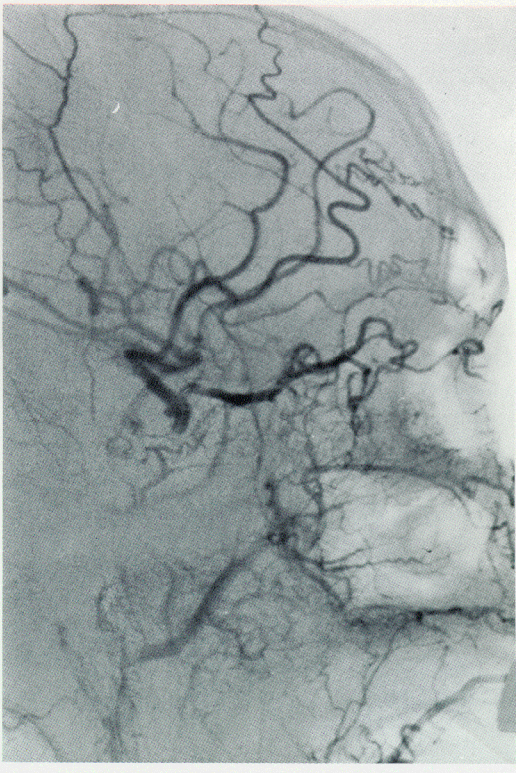


Fig. 2. Occlusion of the internal carotid artery; advanced angiographic phase (photographic subtraction). The ophtalmic artery is visualized rceiving contrast medium countercurrently through the facial artery, the infraorbital artery and the frontal branches of the superficial temporal artcry. This pathway serves the syphon.

other regions have also been considered as they have a specific enough circulatory dependence [1, 2, 3, 4, 5, 6]. These latter are nose and fronto-temporal (f.t.) region. The nose is normally cold, but it becomes warm in conditions of increased flow along the dorsal artery of the nose. For the same reason, collateral perfusion in the superficial temporal artery can justify fronto-temporal hypothermia.

B) Material and method

The study sample is represented by 49 patients who suffered from acute cerebrovascular disease, hospitalized in the Neuro-

Tab. **1. Acute cerebrovascular diseases (49 cases).**

THERMOGRAPHY		*ARTERIOGRAPHY*
pathological (cold f.s.o. triangle)	*38* cases	stenosis/ occlusion carotid axis: 32 cases no stenosis/ occlusion carotid axis: 6 cases
normal	11 cases	stenosis/ occlusion carotid axis: 1 case no stenosis/ occlusion carotid axis: 10 cases

logy Division of the University Hospital of Verona.

As is summarized in Tab. I, a positive f.t.t., meaning a cold f.s.o. triangle, was found in 38 cases (77.5%), whereas in 11 cases (22.5%) there was normothermia without asymmetries.

In 38 patients who had a positive f.t.t., the arteriographic investigation showed 32 of them (84.2%) had stenotic or occlusive lesions of the internal extracranial carotid. Only in 6 cases (15.8%) were extracerebral vascular lesions not found. In fact, as the angigraphy proved, 4 were cases of diffused cerebrovascular lesions and 2 were cases of rupture of intracranial aneurysms. These thermographic « false positives » may depend on asymmetrical haemodynamic alterations in the territory of the ophtalmic artery that give pictures of hypothermia.

In 11 cases in which f.t.t. was pratically normal, angiography showed 10 cases with patent internal extracranial carotid artery and only 1 case of occlusion of it (« false negative » 9.1%).

The f.t.t. is also valid in the identification of stenotic and occlusive lesions of the internal extracranial carotid. In particular one can state that:

1. if the lesion is located in the main carotid artery, the thermography is usually negative;
2. if the lesion is located in the internal carotid artery, from the origin to the ophtalmic artery, the thermographic picture is almost always positive;
3. if the lesion is located in the post-ophtalmic tract, the picture is not constant;
4. if the lesions are bilateral the cold supra-orbital triangle is more evident on the side where the lesion is worse.
5. the threshold for thermographic detection is indicated by a reduction of calibre of the carotid by about 50% [5,6].

C) Results

Regarding the use of f.t.t. in controlling the effectiveness of pharmacological treatment of cerebrovascular lesions, personal experience is based on 24 patients trated with nicergoline *. The sample was divided into 4 groups, according to dosage and modalities of administration.

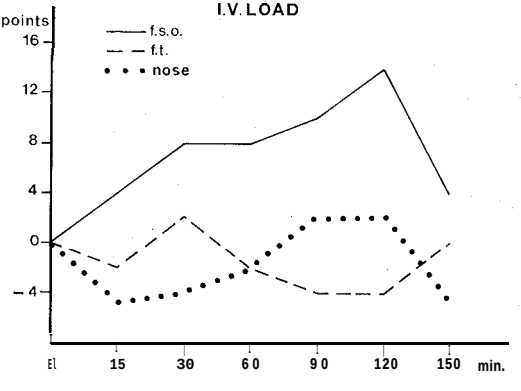
To be able to better appreciate the f.t.t. data, there was taken into account temperature variations also of 0.5°C. An arbitrary score of ± 10 points for a variation of ±0.5°C was chosen.

The drug was well tolerated and did not produce undesirable side-effects apart from the patients of the first group who suffered from a sensation of. diffused heat and sometimes reddening of the face. A slight reduction of arterial pressure was noted and this, in this kind of pathology, is to be considered favourably.

1. The first group, 5 patients, was given a 0.1 mg per kilo of weight dose of nicergoline, divided in two half-doses: the first half directly injected i.v. in l'-2', the second half in a perfusion i.v. of saline. The duration of the perfusion was, on average, 50'-60'. The f.t.t. controls were performed 15', 30', 60', 90', 120', 150' after the introduction of the first dose.

In Tab. II, the thermographic variations, in the three regions considered, for the first group of patients are represented. In the f.s.o. region the drug

Tab. II.

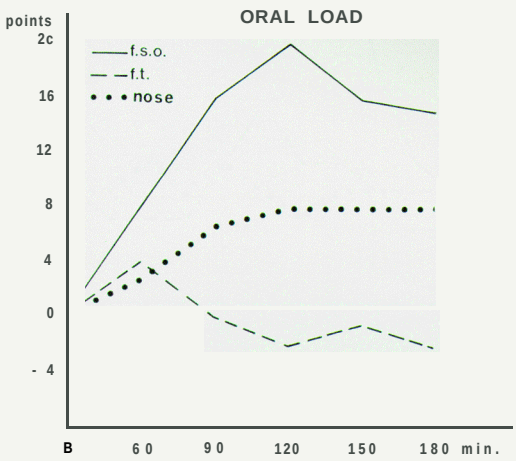


caused a heat increase in the cold triangle, that reached its highest point after 2 hours and then cooled down. The initial cooling of the nose indicates the reduction of the collateral flow in its dorsal artery no longer needed for the supplemental flow to the ophtalmic artery. The later heat increase of the nose probably is due to a diffuse hyperaemia. The f.t. region slowly cools as a consequence of the reduction of collateral flow through the superficial temporal artery.

2. The second group, 6 patients, was given a single oral 0.2 mg per kilo of weight dose. The f.t.t. controls were performed 60', 90', 120', 150', 180' after the administration of the drug.

The oral load (Tab. III) causes a heat

Tab. III.



increase of the cold f.s.o. triangle; it appears to be more continuous and consistent than in the patients submitted to the i.v. load. The later temperature fall, that the patients in the first group had, did not occur as quickly. The nose partecipates in this hyperthermia and tends to remain warm even when the f.s.o. region starts cooling. As the f.s.o. region warms up, the f.t. region becomes colder.

Fig. 3 represents the base-line thermogram of a patient affected by left extracerebral internal carotid artery occlusion, The left f.s.o. region is hypothermic, with a difference of temperature of -0.5°C, in comparison to the correspon-

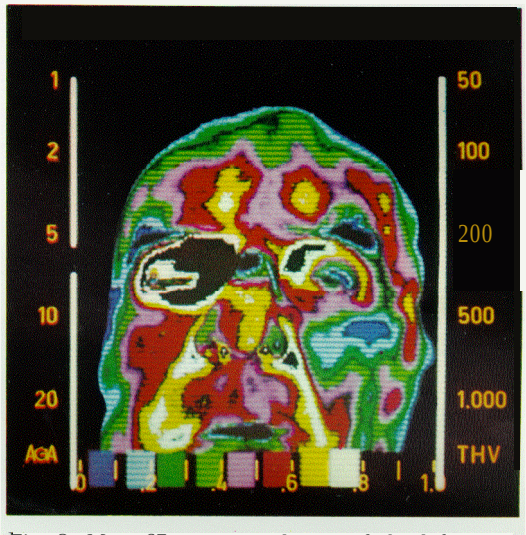


Fig. 3. Man, 67 years: occlusion of the left extracerebral internal artery. Base-line thermogram: cool triangle in left f.s.0. region.

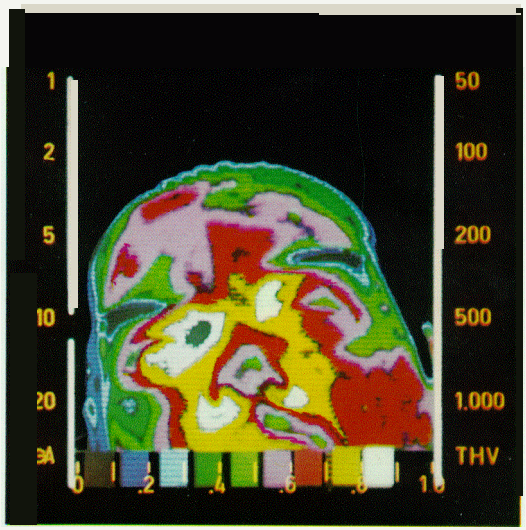


Fig. 4. Same patient as in preceding figure: 120' after oral administration of nicergoline (0.2 mg/kilo). Increase of the temperature of the left f.s.o. region and of the nose.

ding controlateral region. Fig. 4, 120' after the nicergoline oral load, shows a heat increase of the left f.s.0. region and the nose at the same side.

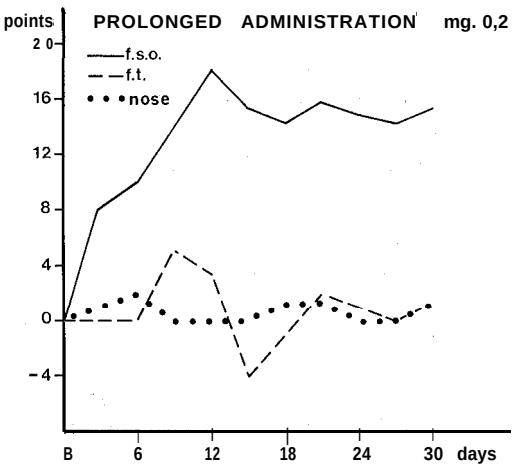
These results suggest some considerations:

a) the real effectiveness of the drug;

b) the oral administration has a better effect than the i.v. administration although one has to consider the different dosages of the drug;

c) the pharmacological effect is greatest between the first and the second hour, both for the i.v. and the oral load.

Tab. IV.



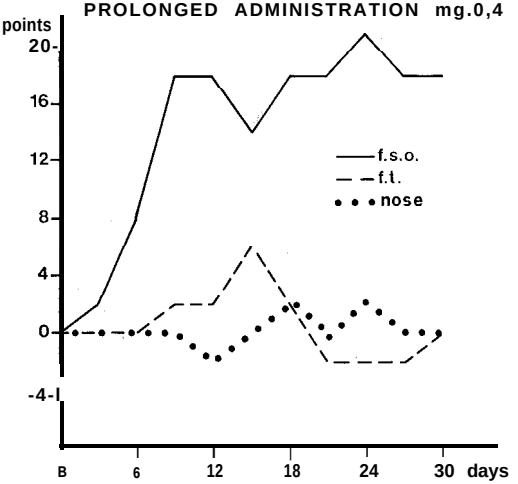
3. The third group, 7 patients, was submitted to a prolonged treatment by fractionated oral dose (3 times a day), up to a total of 0.2 mg/kilo of weight/day.
4. The fourth group, 6 patients, was submitted to a prolonged oral treatment, fractionated during the day (3-5 times a day), up to a total of 0.4 mg/kilo of weight/day.

The patients of these last two groups were submitted to f.t.t. controls every 3 days. The observation period lasted 30 days.

Tab. IV and Tab. V refer to the prolonged treatments. The f.s.o. region shows a heat increase that reaches its highest point between the sixth and the twelfth days. The increase tends to remain constant during the treatment. The thermic patterns in the nasal and f.t. regions are little modified. This latter poor modification is very important because it means that the selective heat increase of the f.s.o. region does not depend on facial hyperaemia but, on the contrary, on an improvement of the flow in the internal carotid system and, consequently, the reduction of collateral flow in the ophtalmic artery.

Fig. 5 represents the base-line thermogram of a patient whose right f.s.o. region

Tab. V.



has a temperature lower by 2°C compared to the corresponding side; after 12 days of prolonged treatment with nicergoline (Fig. 6) an increase of 1°C in this area can be noted, whereas no significant modification in the other regions can be found.

In conclusion, f.t.t. is useful to identify a stenotic or occlusive lesion in the extracranial internal carotid artery. The validity of this method is high (84.2%) and also there are few false positives. F.t.t. can therefore be used as a screening before performing angiography-prior to surgical treatment. In patients that are to be submitted to medical treatment (and they are obviously

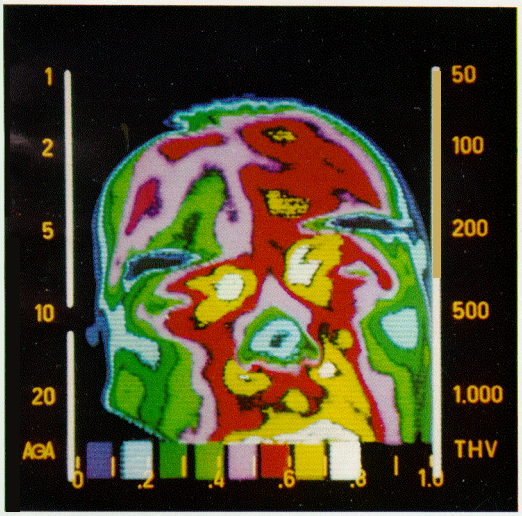


Fig. 5. Man. 63 years: occlusion of the right extracerebral internal carotid. Basc-line thermogram: cool triangle in right f.s.o. region.

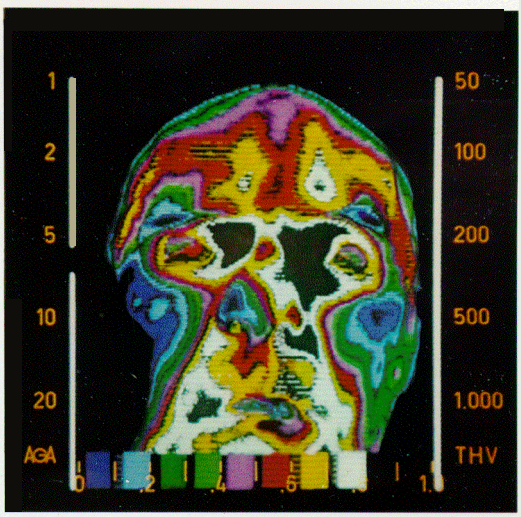


Fig. 6. Same patient as in preceding figure: 12 days after prolonged treatment with 0.4 mg/kilo/day. Increase of' the temperature of the cool area is evident.

the majority) f.t.t. allows evaluation of the results of the treatment and testing the effectiveness of the drugs.

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