8e SEMINAIRE DE TELETHERMOGRAPHIE

Organized by the «Club Français de Tèlèthermographie Clinique» from the 26th to the 28th of June, 1980, at the «ALEXIS CARREL» Faculty of Medicine, Lyon (France).

Coordinator: Prof. M. SCHMITT
'E. HERRIOT' Hospital, Lyon (France)

Round Table

THE FUTURE OF A WOMAN WITH ABNORMAL THERMOGRAM

Chairman: Prof. PAPILLON (Lyon)

The importance of the abnormal and isolated breast thermogram

by J.M. SPITALIER, D. GIRAUD and F. AMALRIC
Cancer institute, Marseilles (France)

Abnormal T., are all the images belonging to the TH3 (a sign of suspicion), TH4 (one sign of malignancy or several signs of suspicion and TH5 (many signs of malignancy) stages, according to the Authors' classification. In the Authors' casuistry there were 95% TH3, 5% TH4 and some TH5 thermograms. Abnormal T. is defined «*isolated*» when there are no radiological or clinical signs of malignancy; it is then considered a T. false positive: its frequency is about 15%. In fact, the screening experiences of various Authors show that often the follow-up of many patients with isolated abnormal breast T., reveals a cancer. A false positive may become a true positive; this way T. can be really considered to be a predictive method. In conclusion, abnormal T. can be considered an important sign of high risk patients. In the Authors' experience 12% of patients with abnormal T. without clinical and radiological suspicion developed a breast cancer in a follow-up period of 1 to 9 yrs; for this reason, an abnormal T. must be considered as a high risk factor.

The significance of an abnormal breast thermogram (infra-red) in asymptomatic women

by A. STARK
Breast Diagnostic Unit, Womens Cancer Detection Society, Queen Elizabeth Hospital, Sheriff Hill, Gateshead, Tyne and Wear (U.K.)

Abnormal T. occur in 13.6% of asymptomatic women. An abnormal T. is non-specific and only indicates some breast abnormality which requires further investigation and long term surveillance. T. has no part to play in the differential diagnosis of breast conditions in a screening clinic. One of the greatest values of T. in well women is as an indicator of a woman risk of breast cancer. About 20% of those with an abnormal T. have developed cancer sooner or later.

Thermography: highest risk marker

by W. HOBBINS

Wisconsin Breast Cancer Detection Foundation, Madison (USA)

Only 15% of cancers determined in breast screening centres have one of the *risk* factors; family history of breast cancer, nulliparity, non-lactation or drug manipulation. T., however, alerts the clinician as to *risk of* cancer in 63% to 85% cases. Equally important in asymptomatic screening, T. selects 80% of cancers in 25% of the population, thereby selecting a high *risk* population for intensive further study. When a patient is identified as thermally abnormal, she is 24 times at greater *risk* than a normal T. patient. These observations are from screening 7,600 women with T. and physical exam. Early data on 5 yr follow-up of subsequent clinical cancers in this screen continues to confirm that 80% of the cancers are in the original abnormal T. population (25%). T. remains the highest *risk* marker for breast cancer!

Follow-up and future of women with thermographic breast abnormalities of dubious significance (TH3 Stage)

by M. GAUTHERIE

Laboratory of Biomedical Thermology, Medical School, Louis Pasteur University, Strasbourg (France)

Infra-red or contact T. is of great help in detecting the fast growth breast cancers negative in prognosis; in fact, T. is often able to reveal, through changes in temperature, the presence of a breast cancer even in the absence of clinical, radiological and echographic signs. Considering a 12 yrs. long experience of 60000 breast T., 1255 patients aged between 32 and 53 yrs, subjected to a thorough follow-up because of their abnormal T., were statistically analysed. The results achieved were as follows: at the time of the first examination 784 patients showed clinically and radiologically normal breasts and 461 a benign mastopathy (337 of cystic disease); a breast cancer was diagnosed at time interval ranging from one month to several yrs in, respectively, 38% and 44% of the examined patients. This high percentage lead to the following 3 considerations: a) the *thorough use* of T. is advised in all breast examinations; β) the *truly abnormal breast* T. may be considered a high risk criteria for breast cancer; *y)* the *follow-up of* these patients, clinically, radiologically and echographically normal, especially if the T. results worsen, has to be formed. In conclusion, it has to be pointed out that, in front of an uncertain T. one has to: *a) evaluate the signficance of* the T. abnormal images by relating to some clinical data, i.e. the superficial vascularisation; β) in presence of really doubtful T., *other examinations* (centred radiographies, ultrasound scanning, needle biopsy) may be performed; γ) if these exams should be negative, a *follow-up* with eventual therapy in line with not only to the T. abnormalities, but to the clinical and psychological situation as well, must be kept in mind.

The future of the abnormal isolated thermograms

by R. AMALRIC, L. THOMASSIN, C. ALTSCHULER and J.M. SPITALIER

Cancer Institute, Marseilles (France)

The fate of 2250 patients with abnormal isolated T. and who were examined between 1970 and January 1978 was looked for; 1420 of these could be followed-up by the Authors.

About 50% of these patients showed a normalisation of their T. in the year following the first exam; more often this was due to hormonal therapy (progestatives). Some 30% of the 730 persisting T. abnormalities were followed by surgery due to the appearance of a palpable tumour, to the worsening of T. (from stage TH3 to TH4), or following the persistance of an abnormal T. after 3 exams at a time interval of 3 to 6 months. 40% of the patients who underwent surgery presented an infiltrating breast cancer, 4 to 5 mm in size, more often adjoining the benign cystic disease lesion. A 5% to 18% (mean value 12%) of patients with abnormal persisting T., and a radiologically or clinically negative exam (the percentage related to the private or hospital sector), and followed-up for a period of 1 to 9 yrs, developed breast cancer. In conclusion the importance of following-up all the patients with persisting abnormal T. must be stressed.

Free Communications

The evolution of some patients with abnormal thermograms

by M. ROMBAUT, C. DORMAL and E. PLUYGERS
De Jolimont Hospital, Haine St. Paul (Belgium)

The 23 women studied with T. and who later developed a breast cancer were considered; they were followed up from 6 to 60 months: 9. of them showed a 1st cancer and 14 of them showed a 2nd cancer. The T. abnormalities between the 1st exam and the last one performed before the diagnosis was made, showed little difference. The following signs were observed: *a) vascular abnormalities* (doubling or dots) or para-areolar vascular isles; all the abnormal vascularisations do not change with time; β) a *progressive heating* of all the breast without vascular abnormality which, especially in the case of the remaining breast is difficult to appreciate; this last point will be especially evaluated.

«Isolated» TH3 and mastodynia

by L. THOMASSIN, R. AMALRIC and D. GIRAUD
Cancer institute, Marseilles (France)

The evolution of 100 consecutive abnormal T. (TH3) in absence of clinical and radiological abnormalities was evaluated. These «isolated» TH3 underwent 2 more controls in a period of 6 to 30 months. Some 86% of the patients examined had some breast symptomatology, more often mastodynia. The control of mastodynia, following or outside treatment showed often a relationship between persistance of TH3 and mastodynia, or between its improvement and the improvement of T.

Evolution of thermography after medical treatment

by A. GORINS, P. SAUVAL and R.A. THIERREE
St. Louis Hospital, Paris (France)

The different results after progestative, antiinflammatory and vascular treatment were investigated. It was demonstrated that progestative drugs are not the sole drugs which cause a vascular emptying with consequent T. improvement.

Round Table

THERMOGRAPHY IN VARICOCELE

Chairman: Prof G.F. PISTOLESI (Verona)

Thermography of the scrotum

by B. FORNAGE, J.L., VALEYRE, P.G. LEMAIRE and B. LARDENNOIS
J. Godinot Institute and C.H.U., Reims (France)

Scrotum T. was performed on 231 recruits of a military base considered to be normal. The way of performing the examination, and in particular the position the patient has adopted is described. The **VALSALVA** manoeuvre is of great help in evaluating the smaller varicoceles and in studying the hemodynamics of all varicoceles as well. The 171 clinically and thermographically normal patients showed a mean scrotum temperature of 29.3°C ± 0,18. A threshold value of 32°C was considered significant for the evaluation of varicocele: therefore a clear relationship between clinical stage of varicocele and maximum temperature of the scrotum may be noted. T. is extremely useful in the diagnosis of varicocele; its diagnostic sensitivity is improved, specially in cases of small and infra-clinical varicoceles, through the **VALSALVA** manoeuvre: the above is indicated in the examination of all sterilities.

Thermographic diagnosis of bilateral varicocele

by C. LAFAYE and J. HERMABESSIERE
Jean Perrin Centre, Cepartment of Physic Methods Clermont-Ferrand (France)

The clinical diagnosis of bilateral varicocele is often difficult; therefore it is necessary to use other methods, particularly scrotal T.: a simple, harmless and useful method of amount examination. 600 scrotal T. were carried out in order to confirm or detect varicoceles in infertile patients (aged between 21 and 39 yrs with an average age of 26 yrs). 14 patients were operated for uni-or bilateral varicocele. This is not indicative of the total amount of varicoceles diagnosed, because only the varicoceles with a high quantity of FSH following

Tab. I. **Physical examination, thermography and surgical intervention.**

Physical examination	Thermography	Surgical intervention
No varicocele	Speramatic cord or scrotum	Size of the veins
Equivocal varicocele		
1 grade varicocele	Thermic gradient	small
2 grade varicocele	$> 1\ ^{o}C$	middle-sized
3 grade varicocele	$< 1\ ^{o}C$	big
Other pathology	negative	

Tab. II. **Correlation between thermography and physical examination.**

Thermography	Physical examination		
	Normal	Positive on one side	Positive on both sides
Normal		3	4
Positive on the side detected by clinical exam	7	85	7
Positive on one side (the other one)		13	
Positive on both sides	1	12	15

stimulation by LHRH, and with consequent alterations of the sperm were operated. A 35% of all the examined patients showed bilateral varicoceles. T. implies a certain delay for its preparation: this allows on one hand balance and on the other hand the re-expansion of the venous reflux. An AGA camera is used at a distance of about one meter. Different positions were used, but the one chosen was the posterior view with the legs slightly apart and the penis out of the field of view. Varicocele is revealed on the thermogram by a high temperature at the level of the spermatic cord or of the hemiscrotum, at the same time. This high temperature must be over $1/2^{o}C$. If the diagnosis of unilateral varicoceles is rather easy, that of the bilateral injuries is more difficult, because of the very principle of T. and of the films, based upon symmetry. For instance in the bilateral lesions the diagnosis will be easily detected with hyperthermia of a spermatic cord, and also of the controlateral hemiscrotum; it will be more difficult, with symmetrical hyperthermia of the two spermatic cords as well as with hyperthermia of the two hemiscrota. It will be necessary to take the temperature of the inside of the right and left thigh as a reference, depending on the standard measure. The results have been codified both on the clinical, T. and surgical plans (Tab. I).

The correlation between physical examination and T. has been shown in 147 cases of bilateral varicoceles (Tab. II), between T. and surgical intervention in 51 cases (Tab. III).

The **diagnosis** of bilateral varicoceles is definitely a rather difficult diagnosis. But several points must be stressed: *a)* the *clinical exam is not sufficient* for the diagnosis of the bilateral varicoceles, accompanied by a small controlateral lesion. Some Authors have shown that there was sometimes a communication between the venous system, but it is sup-

Tab. III. **Correlation between surgery and thermography.**

Surgical intervention	Number of cases	Percentage
In agreement with thermography	34	66%
Intervention positive thermography negative	3	7%
Bilateral varicocele unilateral in thermography	14	27%

posedly more interesting to practise a binding of spermatic veins on each side rather than to hope for a possible flabbiness of the controlateral varicocele; *b) bilateral varicoceles have to be lookedfor systematically* to be sure that a varicocele is not forgotten, if patent on the other side. With exception of infertility, this research is of little interest, since only painful varicoceles are operated; only infertility is an exception since this investigation is quite important, having the following purposes: *a) preventive* in teen-agers and/or young people, for the varicocele seems to be a evolving disease; β) *curative* when infertility has been diagnosed when an incomplete surgical intervention would be really annoying.

Surgical treatment will be carried out on both sides in case of infertility if: *a) FSH is* statistically *more numerous* in bilateral varicoceles (D. **Boucher** and Coll.); *b)* some *azoospermies* may be only cured by surgery of bilateral varicoceles; c) there is *absence of connection* between the uni-or bilaterality of the varicocele and the alteration of the spermogram, the spermoculture, the anomalies of the vesiculo-deferentography and the peroperatory phlebography. The rate of bilateral varicoceles detected in the group studied by the Authors is much more important than that given by other Authors (Dubin 10,3%, Mollet 10,5%, **Pontonnier** 8%). This seems to have something to do with the fact that T. shows a great number of varicoceles. The Authors insist upon the fact that, if not sure (either clinical or thermographical doubt), it was chosen to operate both sides at a time which allowed to confirm in a great number of cases, the clinical or thermographical suspicion. It must also be stressed that an intervention will not enable one to confirm, absolutely, the presence of a varicocele, and that in this particular case, pre or per-operatory phlebography is the ideal diagnostic technique. In conclusion T. is a good examination in the research of varicoceles of the infertile man; it is both reliable and harmless. If the interpretation of the thermogram has to be made blindly, all surgical indication must be thought of only after having compared it to the clinical exam. The T. diagnosis of bilateral varicoceles is of course more difficult than for the unilateral lesions, and its systematic use has led to the consideration of a surgical indication in an important rate of cases (34,5%) in the presented series; it must be stressed that T. made it possible to detect at least one side in case of bilateral varicoceles, in 93% of the considered cases.

The role of scrotal thermography in pre-operative evaluation and post-operative recurrence of varicocele

by J. WEBER, L. BUREAU, C. DIGABEL-CHABAY and F. BUZELIN

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In order to assess the role of scrotal T. in the ted. The pre-operative evaluation for all battery of diagnostic tests for varicocele, 51 patients includes the usual diagnostic procases of hypofertile subjects (40 pre-operative cedures: α) *T. examination*, β) *spermogram*, γ) evaluations, 11 post-operative recurrences) ex- *hormonal test*, δ) *clinical examination.* To plored by the same surgical team were selec- determine histological grading, a testicular

Tab. I. **Correlation between thermography and clinics.**

		Varicocele (Clinically certain)	Varicocele (Clinically doubtful)
Pre-operative examination	Thermo-clinical agreement	21	10
	Thermo-clinical disagreement	4	1
	Thermography inconclusive		2
Post-operative recurrence	Thermo-clinical agreement	4	3
	Thermo-clinical disagreement	1	1
	Thermography inconclusive	1	1

biopsy was performed during the exploration, with the degree of impairment rated from 1 to 3 according to the criteria defined in the study. Spermatic phlebography, however, was not performed systematically because of its inadequacies as well as of its invasive character, and it is thus not considered; nor was Doppler ultrasonography performed systematically. In the results, the patients are classified into 3 groups: a) cases with *good agreement* between T. and clinical examination; b) cases in which T. and clinical findings were in *disagreement;* c) cases in which T. was *not conclusive* (Tab. I).

Thre are however a certain amount of false-negative T. results, yet in the battery of tests no other examination plays such an important role, whether in diagnosis or prognosis. Moreover, T. has the advantage of being simple, noninvasive and relatively inexpensive.

In conclusion, in cases of clinically certain varicocele, a normal or inconclusive T. should not be interpreted as a contraindication to surgical treatment, for it is precisely in this category that results are best and subsequent pregnancies most common. On the other hand, in cases of clinically doubtful varicocele, surgery would seem to be unnecessary if T. is inconclusive and if there is a severe spermatic insufficiency. In case of post-operative recurrence, T. is sometimes difficult to interpret, so that its significance is less apparent. Clinical examination remains the most important test, although it should be noted that very few cases were involved and that a more thorough study is required.

Varicocele

by P. SAUVAL and R.A. THIERREE
Hospital Necker, Paris (France)

The Authors refer their data on varicocele.

Patients 430, mean age of 34; no professional incidence.

Orientation of the request. Sterility 1:1/2; sterility 2:1/8; pain : l/20; post-operative recurrences : l/30.

Spermogram results. Abnormal : 171 cases; normal : 10 cases.

Direct signs of varicocele. Anterior face : l/4; posterior face : l/3; lateral view : l/5; existence of 3 positive informations : l/5; existence of 2 positive informations on 3 : l/4.

Mean level of dysthermia. Left 2°C : 50 %; right 1,5°C : 10 %; bilateral 2,3°C : 10 %.

Valsalva test (in genu pectoral position). Confirmed : 2/5; discovered : 2/5; negative : l/5.

Indirect signs of varicocele. Thigh varicosities : l/5; cross saphen dysthermia : l/4; dystermia of the two faces of the penis : l/20.

Scrotal thermographic examination protocol. Study of anterior scrotum and inferior limbs; study of posterior scrotum associated with the **VALSALVA** test; study of the scrotum by comparative lateral views.

CONCLUSION

The data about varicocele exposed during the Round Table lead to the following reflexions: total number of cases: 2000 cases (Mrs **LAFAYE 600:** P. **SAUVAL** - R.A. **THIERREE 430; G. LA VECCHIA 406; WEBER 325; FORNAGE 225; BERTRAND 26).**

1. Technique

3 views are necessary: *a) raised up* penis; p) *genu pectoral* incidence; y) *lateral.*

Dynamic test employed are: **a)** the **VALSALVA** manoeuvre; *P)cooZing down* (in particular cases).

Necessary criteria are: *difference of temperature* 1 to 2,5°C.

The use of this technique is recommended in male sterility when infraclinic forms are studied (all the Authors) and in the study of late recurrences **(WEBER).** The paradoxal dysthermia (radioclinic distorsion pointed out by Mrs. **LAFAYE, SAUVAL** and **THIERREE)** are explained by observations made by vascular specialists **(BIGOT):** one side is capable to supply the other one.

2. ReSUltS

The results demonstrated the following good correlations: *a)* at the *post-operative T. control,* there is a parallel improvement between T-clinic observation and spermogram. The best results are observed in case of important varicoceles (this favours the theory of hyperthermia as a cause of varicocele). **WEBER** had the chance to analyse testicule biopsies: and to observe good correlation between T. and bioptic data. β) It is important to analyse the varicocele as part of a *more general vascular disease* **(SAUVAL-THIERRBE). WEBER** insisted on: the unfertility improved by deferential veins surgery. γ) There is a *good correlation* between T. results and post-operative follow-up.

In conclusion T. brings original information; the false positives or negatives are minimal.

Free Communications

Chairman: Prof. Y. HOUDAS (Lille)

Sub-clinical varicocele: its detection with doppler and thermography

by B. PELLET, C. MERENDA and Ch. HESSLER

C.H.U.V. Lausanne (Switzerland)

In the andrological section of the department of urology at the Lausanne C.H.U.V. the presence of sub-clinical varicocele in patients showing a spermogram with terato-asteno-oligo-spermia was pointed out. Since it is demonstrated that a clinically diagnosed varicocele can alter the quality of sperm, the Authors want to demonstrate that this may happen in sub-clinical varicoceles as well. In 40 patients with clinical exam negative for varicocele, the **DOPPLER** exam showed the presence of a reflux, while T. was dubious or negative in most

cases. On the contrary, every time T. showed a left scrotal hyperthermia, a puff could be heard performing the VALSALVA manoeuvre. All these patients underwent surgery with high binding of the left spermatic vein; the preoperatory and follow-up spermograms after 3 months were compared. In conclusion, the aim of the work is both to compare these 2 diagnostic methods, and to consider the influence of the high binding of the left spermatic vein on the spermogram.

Comparative study of scrotal thermography and angio-scintigraphy in the check-up of male sterility

by J. ROBERT, P. THOUVENOT and D. REGENT

Department of Nuclear Medicine, Nancy (France)

Fifty three sterile patients suspected of varicocele-were submitted respectively to phlebography of the spermatic veins, scrotal T. and angioscintigraphy of the spermatic vascular axes. Some of them were examined with these techniques before and after the varicocele surgery. Phlebography could be performed, bilaterally, on only 20 patients, while in other cases a doubt existed as to the possible existence of spermatic right venous abnormality. The presence of 33 varicoceles and 30 spermatic valvular insufficiencies was diagnosed. The spermatic valvular insufficiency is characterised by flow back of the contrast product without venous ectasia. T. was performed incident to the anterior face, with the patient in standing position, his penis taped to the lower abdominal wall. Twenty two out of 33 varicoceles showed a thermal abnormality while only 9 cases of spermatic valvular insufficiency had a scrotal hyperthermia; this means a detectibility of 70% for varicocele and 30% for spermatic valvular insufficiency. Angioscintigraphy examination was performed after intravenous injection of ^{99m}Tc Pertechnetate. A sequence of 16 images in 15 s was realised. In an early stage net hyperactivity facing the testis and its expansion towards the homolateral inguinal orifice was visualised in 32 out of 33 cases of varicoceles. In spermatic valvular insufficiency, the hyperactivity is more moderate, progressive and, often limited to the region of the scrotum. In 23 cases, the angioscintigraphy revealed this abnormality. Thus the efficiency of detection by angioscintigraphy is 97% for the varicoceles and 77% in cases of spermatic valvular insufficiency. The rate of false positive cases is slightly larger for T. than for angioscintigraphy. In fact, among the 14 phlebographically normal venous networks, T. has demonstrated thermal abnormalities in 3 cases, while only 2 were detected by angioscintigraphy, which were nearly pathological. According to this study, angioscintigraphy seems to be the complementary examination for all the problems of male sterility; this considering its non-invasiveness and the excellent results given; on the contrary T., while useful for the detection of varicocele, is of little help in the study of the spermatic valvular insufficiency.

Thermography in sterilities with varicoceles

by H. ROLLET, A. BREMOND, M. SCHMITT and C. DUFOUR

E. Herriot Hospital, Lyon (France)

286 patients examined due to sterility problems in the Obstetrics Department of Herriot Hospital were the object of this study. All the patients showed to have varicocele; all

of them had one or more spermograms, 243 had a T., 274 were submitted to a Doppler investigation in order to research the presence of a reflux and, finally, 117 of them were subjetted to spermatic phlebography. The correlation of clinical, ultrasonic, phlebographic and spermocytographic results with those of T. are showed in Tab. I.

Tab. I. **Correlation between thermography and other investigations.**

PATHOLOGY (according to the mentioned method)	No	THERMOGRAPHY		
		positive (> 1 °C)	doubtful (0,5-1 °C)	negative (symmetry)
Clinic: large varicocele	76	62 (82%)	7 (9%)	7 (9%)
Clinic: suspicion of varicocele	143	95 (66,4%)	10 (7%)	38 (26,6%)
Ultrasound: reflux at Doppler investigation	159	115 (72%)	14 (9%)	30 (19%)
Phlebography: positive	47	34 (72,5%)	4 (8,4%)	9 (19,1%)
Significative Spermocytogramme	69	43 (62,3%)	8 (11,7%)	18 (26%)

Thermographic results in the praxis of clinical diagnosis of varicocele

by J.L. LAMARQUE, J.M. BRUEL and J.P. ROUANET

Radiology Department, St. El01 Hospital, Montpellier (France)

The T. patterns of 140 patients with sterility or abnormal spermogram were reviewed. The examinations were performed with an AGA 680 Medical T. Camera, in the classical way, i.e. the examination of the anterior and posterior scrotum. The T. results were as follows: a) T. diagnosis of varicocele in 106/140 cases; β) negative T. in 34/140 cases. Totally 88/106 varicoceles were confirmed after surgery, 17 of them were only diagnosed by T., being clinically negative.

The interest of telethermography in the research of varicocele

by A. VANDENBROUCKE-VAN DER WIELEN and S. DE COOMAN

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In total 167 patients consulting for infertility were examined with an AGA 680 M thermograph. The examination is performed in a room at a constant temperature between 20°C and 22°C. The penis is fixed to the abdomen; the recordings are made in 3 incidences: face - left and right oblique views. The pictures are recorded on a Polaroid blue-and-white or colour film. The maximum difference in temperature between the hyperthermic area and

Tab. I. **light hyperthermia: average temperature.**

Clinical examination	No	Threshold temperature	Average temperature Gii)	DS
No varicocele	1		(1)	
Doubtful	18	1° - 4,5°	2,33	0,98
Small varicocele	32	I° - 6°	3 1	I,19
Middle-size varicocele	24	150 - 7°	4,08	I,46
Important varicocele	19	2° - 6°	4,07	I,09

t TEST m Doubtful varicoceles / m Small varicoceles = p = 0,05

m Small varicoceles / iii Middle-size varicoceles = 0,005 < p < 0,001

the symmetric point of the controlateral hemiscrotum, and on the other hand, between the hyperthermic area and the upper-inner side of the thigh were studied. In all cases of middle-size varicocele (grade II) and also in case of important varicocele (grade III) T. was positive. The positivity in the small varicocele cases was 75% (grade I), in clinically doubtful cases 57% and in clinically negative cases it % was 17% 3,8% of the varicoceles were situated on the right, 89,5% on the left and 6,6% were bilateral. Tab. I shows the left-sided hyperthermia and points to out that the differences of the average temperature between the clinical doubtful varicoceles and the small varicoceles are statistically significant (p=0,05); and still more significant are the differences between the small varicoceles (grade I) and the middle-size varicoceles (grade II) (0,005<p<0,001). In other words, there is an excellent correlation between the clinical dimension of the varicocele and its thermic expression. The Authors also found that the absolute temperature increases in a linear way in relation with the thermic factor. An absolute temperature <30°C is incompatible with the existence of a varicocele. It is pointed out that the oblique incidences are necessary when the face recording is negative or doubtful; it is also necessary in bilateral hyperthermia, where this incidence gives the possibility of finding out the side with the highest temperature. In conclusion: a) T. is particularly useful in *clinical doubtful cases of* varicocele, and in small varicoceles (grade 1); β) the *oblique incidence* is very useful; γ) an *absolute temperature<30°C* is incompatible with the existence of a varicocele.

Thermographic diagnosis and post-operative control of varicocele

by S.D. BIANCHI, G. GATTI, P.E. DESOGUS, D. FONTANA and D.F. RANDONE

Department of Radiology, "Le Molinette" Hospital, Torino (Italy)

A more accurate diagnosis can be made in cases of varicocele if the T. data are related to the clinical ones. Totally 206 subjects with clinical evidence of varicocele were examined. Various degrees of dyspermia were seen in 81/95 of the series, while 61/95 were treated surgically and followed up at fixed times. A Δ°C of over 0.5°C was regarded as a positive T.

Tab. I. **Thermography in varicocele.**

Thermography / Clinic	Positive	Negative	Total
Positive	70	11	81
Negative	11	3	14
Total	81	14	95

finding. It was found that the extent of the hyperthermic area of a varicocele is proportional to its size on palpation (Tab. I). There was no relation between the extent of hyperthermia and the degree of oligospermia. T. offered useful information on the presence of persistence or recurrence (6/61). There was a good qualitative relation between reduction of the hyperthermit gradient and seminal fluid improvement. No seminal improvement was noted in cases of persistance or recurrence. T. is therefore useful because: a) it indicates the harmful effect of varicocele on *spermatogenesis; p)* it supplies quantitative data that *supplement the subjectivepicture* after palpation; y) it provides an objective means of *assessing the results of surgery.*

Thermography and phlebography of the dorsal vein of the penis in sexual disorders of venous etiology

by J.M. BIGOT, R.A. THIERREE and G. TORDJMAN
Necker and St. Louis Hospitals, Paris (France)

The diagnosis of these disorders rests upon clinical and para-clinical arguments: a) *Clinical arguments:* the 20 examined patients presented a non lasting although well programmed erection; they presented the following pathognomonic sign which convinced them to undergo phlebography, i.e. a better erection of the penis in standing position. b) *Paraclinical arguments:* T. shows extremely well the venous stasis at the anastomoses of the root of the penis. Phlebography permits one to evaluate the 2 following points: the *dilatation* of the deep pelvic anastomotic network, this demonstrating the valvular insufficiency described by **FITZPATRICK;** the *venous hyperpressure* during catheterization in general anesthesia; considering the threshold values ranging between 6 and 8 mm Hg according to **REINHARETZ,** the pressure exceeded in the considered cases the 13 mmHg, thus giving a significant pathogenic explanation. The binding after phlebography quickly allows an erection to take place: this is anyway of short duration. In conclusion, the contemporary arteriographies have shown in 19/20 patients discrete arterial lesions. Therefore the sexual disorders will achieve full sense, as soon as minimum arterial lesions are discovered.

The clinical value of thermography in varicocele

by G. ALEI, G. BONANNI, M. COLAVITE and G. DE VECCHI
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The T. results in varicocele were compared with the clinical and surgical results. *406* patients were examined; they were divided into two groups: a) 232 patients had *evident varicocele* (2nd-3rd grade); β) 174 patients had *suspicion of varicocele* or 1st grade varicocele.

In the first group T. was positive in 97% of the examined patients; the second group had T. positive in 69% of the cases. There was no difference in the clinical, T. and surgical results in the first group patients who underwent surgery. Only 91 T. positive patients of the second group underwent surgery; 87 of them presented concordance between T. and surgical results: this confirms the usefulness of the method. Finally, 79 patients were followed-up by T. after surgery in order to evaluate the normalisation of the T. pattern or to discover possible recurrences (3 cases).

Round Table

THERMOGRAPHY IN TRAUMATOLOGY AND RECONSTRUCTIVE SURGERY

Chairman: Prof. DEJORN (Lyon)

Hyperthermic images in cases of muscle accidents sustained by athletes

by P. ROCHCONGAR① and A. BELOSSI②

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Muscle accidents constitute a 25% of consultations in sport traumatology. GENETY rightly mentions that 90% of these accidents concern the lower limbs. This type of accidents requires an early and accurate diagnosis, necessary for the attitude to be adopted as well as for prognosis, the latter is of great importance for athletes. Until several yrs ago, only clinical investigation was available in order to examine these injuries. Though it is now possible to introduce additional extremely helpful investigations, the major importance of the first stage which includes questioning, inspecting and palpation must be stressed. Only in a second stage the physician will resort to additional examinations. such as radiography, echography and T. Before dealing with T. a short reminder of the various muscle lesions likely to be met must be introduced.

a) *Contusion or bruising:* the only circumstance which necessarily involves contact. It only interests one in connection with the possible internal injury of the muscle that has been damaged. b) *Contracture:* (non in neurological terms). It corresponds to ((stiffness D and never involves macroscopic lesions of the muscle. *c) Elongation:* it corresponds to a sudden pain occuring during an effort or in a more insidious way. Palpation reveals a hardened cord in the muscle. d) *Strain:* well known by specialists in sport medicine. It is a sudden and painful accident which, as a rule, stops the victim in the middle of his activity. Strains correspond to the limited rupture of a few muscle libres. e) *Tear,* in some cases even *rupture:* it corresponds ,to a more largely spread lesion of the muscle. It is interesting to differentiate between the 2 latter cases, for T. will give different images. Besides, the period of inactivity and re-education will be much longer in the case of a torn muscle. T., performed with an AGA 680 camera, is of major importance in complementary investigations. It must however comply with a number of principles: the patient must not have undergone massage or applications of ointment for a few h., the injury must be comparatively superficial; it must be remembered that some muscles

(mainly the semitendinosus, semimembranosus and biceps femoris) can cause erroneous results and that a minimum thermic increase of 0.X is necessary; lower figures will only be accepted if there is a very close link between clinical investigation and thermic pictures. Having introduced these preliminary remarks, the hyperthermic images can be classified into the following categories:

1. Recent injuries. The appearing of a temperature increase image signals the presence of a muscle lesion. In the case of major injuries or of a torn muscle, the image will be transitory (a few h after the accident) and replaced by a temperature lowering image, On the other hand, in the cases of minor injuries (such as strains), the temperature increase image will persist for several days, or even for several wks. The appearance of temperature increase images unmistakably signals the muscle lesion, compels the subject to interrupt physical activities, and may offer an important medico-legal interest especially in the case of professional athletes. Recovery is exclusively revealed by the disappearance of this image. It is then possible to progressively resume physical activities. But, unlike **ZUINEN,** the Authors were not able to note any close parallel between a reduction in hyperthermia and healing.

2. Old **lesions.** T. seems to supply very interesting informations. In fact, a number of mistakes in diagnosis and therapy, or even more simple the subject's impatience, cause the required period of inactivity to be neglected. In the case of muscles that have been torn and bruised, the bruise is unfortunately liable to transformation and calcification. This developing calcification can become the cause of a major functional impotence. T. is of prognostic value as well, since it shows a temperature increase image corresponding to the calcification. The disappearance of this temperature increase image after a period of rest (2 to 3 months) and radiotherapy (1000 rad over 5 sessions) makes it possible to progressively resume physical activities in the best possible conditions.

In conclusion, T. may be considered an important complementary method of investigation in the case of muscle accidents sustained by athletes. Images of hyperthermia essentially help to improve the diagnosis and the prognosis; they are of important medico-legal value as well.

The hypothermic images of the muscular injuries of the athlete

by P. HUGEUX, J. GENETY, E. BRUNET-GUEDJ and M. SCHMITT

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The daily experience reveals the problems facing the physician confronted with sports-oriented muscular injuries. The difficulties involved with an acute injury include: a) the precise *determination of the severity* of the injury; p) thefollow-up of its anatomic evolution; *y)* the *accurate prediction* of the date when athletic competition may be resumed. A chronic injury, represented by a painful, functional limitation of movement, presents the difficulties of finding a precise organic support for the symptomatology, and of adopting an efficient therapeutic treatment. In the case of a muscular injury, a simple clinical examination is often insufficient to provide a precise diagnosis, and the need for complementary examinations becomes evident. Until recently a radiological examination was the only paraclinical method available for the examination of muscle injuries. This examination was used to check for post-traumatic ossification, a quite uncommun painful sequela. P. **MEFFRE** initially explored the usefulness of T. in muscle injury examinations; 3 yrs later, 150 additional

examinations modified his initial findings. The hypothermic images found in muscle injuries provide useful information in 3 related areas: 1) serious, acute injuries; 2) poorly, or non-labeled painful sequelae; 3) post-operative control of surgical lesions.

1. Serious, acute injuries (tears, ruptures, contusions). The hypothermic image is seen in the initial phase of the injury, which itself evolves over 3 periods: a) *Istperiod:* hypothermia above and below the lesion. This hypothermic image may be segmentary; it may also encompass the entire limb, thereby masking the hyperthermia centered on the lesion; b) *2ndperiod:* disappearance of hypothermia with the subsequent revelation of the hyperthermia centered upon the lesion; *c) 3rd period:* normalisation of the thermal image. The hypothermic image reflects the pain-induced vasoconstriction. This explains the extreme frequency both in severe contusions of the quadriceps femoris and in tears of the triceps surae, which are together the most painful accidents. Such reactions are more uncommon in tears of the quadriceps femoris and hamstring muscles. Clinically, they correspond to an abnormally painful symptomatology. The initial hypothermic image's most useful parameter is its duration, rather than its extent or intensity. It must be emphasized that: a) the persistance of the *image for more than 1 wk* signifies either a correctely treated yet especially severe injury, or a neglected or insufficiently treated injury; p) the persistence of the *image for more than* 2 *wks* signifies at best, a long evolution and a delay in the resumption of competition, and, at worst, an underlying complication. In this situation, there were several cases of post-traumatic ossification in the quadriceps; in one case concerning the triceps surae, there was a lengthy delay in the resumption of competitive activity, with a progressive disappearance of the hypothermic images over a 3 months time.

2. Painful sequelae. These include the injuries where, despite negative clinical and radiological examinations, a painful limitation of movement persists. Apart from the G subjective pain>) rather frequent in athletics, they signify librosic scar tissue in the muscle body, or adherences which limit the sliding of tissue over eachother. T., by visualizing a hypothermic image centered on a painful region, can provide an objective document which can support a diagnosis, indicate a therapy and follow-up its efficiency. Its interest is especially evident in the painful sequelae of the hamstring muscles, where a routine examination is frequently negative; it is less important in cases where the triceps surae and quadriceps muscles are concerned: this being the disinsertion of the medial gastrocnemius and partial ruptures of the rectus femoris usually accessible to palpation. It must be noted, however, that T. presents some certain, non negligible limits: a) the *non visualisation* of deep or small scars, and the traumatic ossifications in contact with the femoral bone; b) excesses *in the images* of the calf where a hypothermic image can often reflect local vascular problems. Outside these limitations, the progressive normalisation of the thermic image provides an accurate reflection of the healing of the injury.

3. Post operative follow-up of surgical lesions. The necessity of surgery after the failure of medical treatment is a function of the degree of pain-oriented disability rather than the result of a clinical examination or a T. image. Surgery is most often indicated for the report of painful scars resulting from injuries to the rectus femoris, and to the medial head of the gastrocnemius muscle. Whatever the recovery after the excision of the pain-causing fibrous tissue, the post-operative evolution is monitored by T. Experience has shown that a normalisation of the image is seen after a period ranging from 3 to 6 months. As this normalisation is an excellent sign of anatomic restoration, it allows for a progressive resumption of competitive activity. T. is a useful complement to the standard clinical examination of muscle injuries. The interpretation of the results must be done as a function of the evolutive context. In this case, the hypothermic images take their value in muscular traumatology through the collaboration of the clinician and thermographist.

Thermography in diagnosis and follow-up of muscular lesions in sports-events

by J.L. LAMARQUE, J.P. ROUANET, J.M. BRUEL, J. MARIOTTI, H.D. BISCIGLIA, P. CAIZERGUES and B. SERROU

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The medical control of sportsmen and in particular in professional soccer players shows the following problems: diagnostic confirmation of muscular lesions; follow-up; judgement of the possibility of recovery. The Authors followed, for more than 6 months, the professional team A. S. Paillade of Montpellier; T. results were unclear. In this report they try to explain the results in function of the chronic or acute type of the lesion.

Thermography in microvascular surgery

by J.L. BOVET, J. BAUDET, M.H. DILHUIDY and A. LE TREUT

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With the recent progress of microsurgical techniques it is possible to perform small vessel anastomosis with a good percentage of success, both in the permeability of the suture and the persistance of the blood flow. Therefore, if the recipient vessels are suitable, amputated segments of the limbs may be reimplanted, a cutaneous territory may be transferred; this in one operative time in any point of the body. Very often after the vascular clamps have been released, rapid coloration of the segment followed by a warming up may be obtained. If this lasts the surgery was successful, but sometimes thrombosis may complicate the further evolution. Thrombosis may be detected early by clinical or monitored surveillance. In arterial thrombosis, skin is pale, cold, without capillary pulse. In venous thrombosis, skin is dark with a rapid capillary pulse return. The diagnosis of such a complication requires surgical control of the anastomosis. But sometimes thrombosis is not clear and the circulatory deficiency is not evident. Besides classical paraclinical examinations (as plethysmography, thermometry, etc.). T. is of great interest in the examination of these complications: in fact T. precedes the clinical state. Authors delimited thermographically the temperature range within which the survival of transplant and of reimplantation can be expected. In all the cases studied the evolution confirmed the T. prognosis. This range of temperature depends on the type of examined tissue.

a) In *fingers reimplantations* it must be emphasized that the section of the arteries causes local sympathectomy, therefore the reimplanted fingers can sometimes be warmer than the surrounding tissues. In the first days the reimplanted fingers has a temperature lower than normal. A 4°C difference between the reimplanted fingers and a control area is the threshold value of survival. Beyond 5°C there is not possibility even of seeing a partial survival of the tissue. b) In *seriously traumatised hands* the heating can be produced by underground tissues. In these cases a limited range of temperature (3°C) can be followed by necrosis of the transferred tissues. c) In *free flap transfers* the heating can be produced from underneath or through the edges of the flap. In arterial thrombosis a characteristic feature is the difference of temperature between the central part of the flap and the periphery with a progressively decreasing temperature from the periphery to the centre (concentric zones of hypothermia). A 4°C difference between the centre and the edges is sufficient to assess the arterial thrombosis. In venous insufficiency the flap presents a slow and moderate decrease of temperature on its whole surface. In these cases only 2 consecutive examinations can give significant data on evolution.

The use of thermographic examination in evaluating the functional results of digital reimplantations

by H.G. BERTRAND, M. SCHMITT, and J.J. COMTET

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Seventy four reimplantations, corresponding to 57 patients, have been performed since 1975 by the staff of Plastic and Burn Surgery. In 45 cases the patients required the reimplantation of one finger (the thumb in 40% of cases) while the remaining 12 cases required the reimplantation of 2, 3 or 4 fingers. The reimplantations were successful in 77% of the cases, with a better chance of success for' those cases in which the amputation was incomplete (13 cases) and the wound was clean. These accidents were most often in men aged between 20 and 40 yrs; yet children and elderly persons were not exempt from this type of accident. The average age of the patient was 32 yrs, the age limits being between 2 l/2 and 76 yrs, respectively. Thirty six of these reimplantations were re-examined after more than 1 yr. They were examined using infra-red T. as well as a Doppler examination. The functional level of the reimplantations was established using the eight criteria set down by W. **MITZ,** and which are: α) *aesthetic aspect*; β) *trophicity and tolerance to cold*; γ) *vascularisation*; δ) *sensitivity*; ε) *motricity*; ζ) *global function and usefulness*; η) *number of operations*; ϑ) *total duration of absence* from work. Overall, the functional results of the reimplantations paralleled the quality of the vascularisation of fingers in question. This vascularisation can be easily studied using infra-red T. Comparing infra-red T. and velocimetry (Doppler), one will note that if the 2 collateral arteries are allowing the blood to flow, the reimplanted finger is normothermic in 81% of the cases. If, on the other hand, neither artery is allowing the blood to flow, the finger is hypothermic in 75% of the cases. Therefore, a good correlation between the 2 methods of examination can be noted. From a T. point of view, 3 factors were analysed:

1. Tolerance to the cold. 85% of the patients having undergone a reimplantation complained of variable degrees of pain due to the cold. The absence of a sensation of coldness always corresponded to normothermic fingers. However, the cold-related pains were found in normothermic, as well as hypothermic fingers. The vascularisation is, therefore, not the only factor behind these troubles. The recovery of sensitivity in the finger represents the other principal factor behind the intolerance to the cold.

2. The recovery of sensitivity. The finger tips of the reimplanted fingers were examined. The cases in which the recovery of sensitvity was complete (54) always corresponded to normothermic fingers. A normothermic finger recovered a useful level of sensitivity (S3; **S3 + S4)** in 92% of the cases. However, a hypothermic finger recovered a useful sensitivity in only 57% of the cases. The degree of sensitivity recovery depends greatly upon the vascularisation. It also depends upon the age of the patient, and the initial injury (clean wound, crushing injury, etc...).

3. Global results. All the normothermic fingers had a fairly good, good, or excellent final result. One must also note, however, that a hypothermic finger does not necessarily entail a poor result; yet, all the poor and mediocre results correspond to hypothermic lingers. Half of the T. performed soon after reimplantation revealed hyperthermic fingers (due to the effects of sympathectomy), while the other half revealed hypothermic fingers. The difference in temperature between the reimplanted finger and the other fingers tends to disappear with time. The interest in an early T. test lies principally in the determination of whether or not a rivascularisation (via venous graft of a collateral artery) is indicated. Where rivascularisation is indicated, the T. image is typical: the reimplanted finger appears detached at the site of the amputation with a resulting hypothermia of several degrees with respect to the neighbouring fingers. The functio-

nal evaluation of digital reimplantations performed since 1975 was systematically accompanied by T. In some cases an early T. was performed about the 3rd wk after reimplantation, with all the reimplanted fingers benefitting from a later T. examination. These examinations allowed one to establish an undeniable relationship between the final results and, on the one hand, the quality of the vascularisation (also verified via **DOPPLER** examination), and, on the other hand, the functional results. The initial hyperthermia is normal (due to the effects of the sympathectomy), and is of good prognostic value. A hypothermia has a poorer prognosis, and requires, in some cases, a rivascularisation via arterial graft. In the long run, a finger, moreover a hand, with a good vascularisation and an evolution towards normothermia, will generally present good results from the point of view of trophicity, cold tolerance, mobility and recovery of sensitivity. On the other hand, a hypothermic finger recovers less and often presents an intollerance to the cold, as well as a stiffness and deficit in sensitivity. These results can be applied to all trauma-oriented surgery of the hand by pointing out the importance of repairing as many blood vessels as possible: the better the vascularisation (shown using T.), the better the final results will prove to be.

Free Communications

Chairman: Prof. M. PRATS-ESTEVE (Barcelone)

Telethermography and xero-radiography for medico-legal evaluation of the muscular, tendon and articular damage

by A.A. ASCARELLI, G. UMANI RONCHI, R. GRAVINA and A. POLLARI
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The usefulness of T. associated with xero-radiography in the medico-legal evaluation of articular, capsular, legamental, muscular and tendineous damages, with no or insufficient clinical evidence is illustrated. T. gives excellent results in the study of the small (i.e. hands and feet) and of the large joints (i.e. elbow and knee) where the examination is not altered by the presence of arteries or veins nearby. Being neither harmful nor expensive, repeated examinations are possible: this in order to follow-up evolution of the lesion, and to estimate the time of temporary incapacity. A black and white T. is very important in order to evaluate the aspect and the course of the superficial vessels; this in order to distinguish between post-traumatic alterations and a pre-existent vascular pathology not related to the trauma. In fact, in a colour T., there could be superimposition of either vascular, or physiological, or pathological elements not connected to the traumatic lesions. In conclusion the association of xero-radiography and T. is a useful complementary method in the medico-legal study of temporary or permanent incapacity.

The injuries of the knee and the skin thermography

by F. LELIK
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The ligamentous system of the knee is often injured due to sports practice. These injuries are a great problem for an orthopaedic surgeon since mistake in diagnosis or treatment can lead to instability or algodystrophia. Several Authors emphazised that an accurate diagnosis is a hard and delicate task; it must be added that the precise follow-up is equally difficult. Even the diagnosis of an expert surgeon backed up by every possible instrumental aid, proves to be either over-optimistic, or excessively pessimistic. Functional assessment is pointed out as being the focal point of objective examination; but the «functio laesa» is one of the five cardinal symptoms of inflammation and at every form of it the << calor >> is always present. Otherwise the local rise of temperature, location, extent, and the grade of inflammation are measurable by T. Injuries of the medial collateral ligament are the most frequent forms; they may be divided into 3 degrees, as follows: a) *1st degree* in which the typical pathological signs are: α) *hot spot* in the form of a vertical line, or; β) a *small stain* in the projection of the articular line, or; γ) a *raindrop shape;* b) *2nd degree* in which the hot spot is large, valgus laxity is demonstrable and a 60 cc bloody effusion is available; c) *3rd degree* in which the medial half of the joint was uniformly hot and the involved anatomical parts could not be distinguished. Combined injuries were always found in 3rd degree cases: meniscal injuries or even the 0' **DONOGHUE'S** unhappy triad. In meniscal injuries and damages the vascular details of the regiAn can be well demonstrated, that in the anchorage of the medial menisc, the vessel network, the wedge shape; but this does not provide an indication for immediate surgery. If, despite of conservative management, the hot spot remains unchanged for some time surgery is advisable. In the lateral compartment the injuries are more rare and detectable. Since the anatomical relations are complicated, the classification is difficult. We encountered cases where the hot spot was in front of the lateral margin of the patella, none at the **GERDY** tubercle, or even at the head of the fibula. These injuries are a common sign: recovery is slow and delayed.

Thermography in mountain chilblains

by M. SCHMITT and J. FORAY
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The diagnosis of mountain chilblains is easy, its physiopathological mechanism is well known, its treatment well codified, but an early diagnosis is so far an unresolved problem; the Authors applied to T., examining 39 out of 450 patients. T. gives 2 pictures: the lesional and the peri-lesional picture. The lesional picture shows hyperthermia in superficial chilblains and hypothermia in deep frost-bites. The peri-lesional picture almost always shows hypothermia which is the vasomotor consequence of the frost-bite. The Authors wished to delimit through T. the center of the circulatory stop, that is the area where the necrosis develops. The results were unsatisfactory but such an examination can be useful, because of its low cost, in the screening of high risk subjects.

Thermography in muscular lesions due to acute poisoning

by F. SAUDIN, CR. TEISSEYRE, R. DUCLUZEAU, M. SCHMITT and J.M. ROUZIOUX
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Rhabdomyolyses are typical but rare in acute poisoning; they were described after use of several depressant drugs of the central nervous system. In the last yrs 12 poisoned patients with rhabdomyolysis were accepted by the Department of Toxicology and Legal Medicine; 7/12 recovered perfectly, while 5/12 had more or less serious complications from the functional, sensitive or motor point of view. All the patients underwent the following exams: *a) laboratory studies,* such as blood ionogram, creatinine, **ALT, AST, CPK, LDM** and research of myoglobinuria; β) *one or more* T. T. allows to determine the site of the muscular lesion and the thermic elevation. The importance of muscle lysis can be quantified by means of an index: this is obtained multiplying the A t°C for the extension of the hyperthermic zone, the latter on a percentage basis of the total body surface. The comparison between the T. results and the isolated laboratory results do not show any relationship. On the contrary, there is a significant relation between the transaminasis value and the T. index.

Thermography and bone setting

by J.M. ARANDES RENU, M. PRATS ESTEVE, M.A. SALVADOR ONZAIN and L. PUIDOMENECH
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The evolution of a fracture towards healing, delay in setting or pseudoarthrosis, is difficult to evaluate, since the histological processes are not in strict relationship with the clinical and radiological examinations. T. was therefore performed as a complement of the clinical and radiological examinations; this was done in order to study, dynamically, the normal or abnormal evolution of the fracture setting and to compare the T. results with histology, diaphanoscopy, microangiography and nuclear medicine. In the normal setting of fractures, the T. results preceded the radiological ones; in late setting T. revealed the delay of the setting, particularly during the 2nd and 3rd stage. When the fracture evolves toward pseudoarthrosis, the T. result depends upon the type of pseudoarthrosis: floating, avascular, hypervascular or infectious. α) In *floating pseudoarthrosis* the Authors claim to have no experience; β) in *avascular pseudoarthrosis* T. permits an early detection of the absence of the hyperthermic responce, typical of the 2nd stage of consolidation; *y)* in *hypervascular pseudoarthrosis* T. seems to be of the greatest interest. In fact the radiography and histology do not permit to distinguish between the evolution towards pseudoarthrosis and the delay in fracture setting until 6 months have elapsed from the date of the fracture; on the contrary T. shows, in hypervascular pseudoarthrosis, an early disappearance of the 3rd stage hyperthermia: this does not happen in the delay of fracture setting. Therefore, in the absence of a radiological setting pattern the disappearance of hyperthermia means an evolution towards hypervascular pseudoarthrosis; δ) in *infectious pseudoarthrosis* hyperthermia will, on the contrary, be present.

DERMATOLOGY

Chairman: Dr. M. GAUTHERIE (Strasbourg)

Telethermography in skin ulcers

by D. GIRAUD, J.P. CASTAIGNE
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Infra-red T. in trophic skin ulcers is not a diagnostic method, but it is an original and safe means in the follow-up of medical treatment. The Authors refer to their experience in the administration of a new drug, *Ticlopidine.* In the evaluation of the results the three following points were stressed: *a) global vascularisation of the 2 lower limbs* with a plantar view; β) vascularisation of the *edges of the ulcer*; γ) *aspect of the ulcer* itself.

The results in the 24 treated patients were very promising. T. allows one not only to analyse the vascular condition of the limbs and the healing stage of the ulcer, but it also allows one to appreciate the quality of the new skin-cover.

Application of thermometry and thermography to the quantitative estimation of solar erythema

by M.C. MARTINI,① M. DUNAND① and M. SCHMITT②
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Infra-red T. and radio thermometry (**HEIMAN'S** bolometer) are used for a quantitative estimation of the rise in skin temperature due to solar erythema caused artificially by irradiating the examined subjects with radiation sources like the high pressure mercury vapour lamp and the xenon tube type. Experimental conditions being strictly defined, especially the spectral and energy characteristics of the source, as well as the thermostatic control of the subjects, this technique can be applied to the estimation of the effectiveness of protection of filter products, and thus can determine a protection factor. So-called «control» zones are prepared on half of the back of the subjects, and these remain unprotected. The test product is applied to the other zones. The whole area is irradiated for sufficient time to cause a temperature rise of at least 1°C in the unprotected zones. These are measured 1Oh after irradiation, and the values obtained compared to those of symmetrical areas delimited on the other half of the back, which have never been irradiated. This yields a factor from 0 to 10, related to the erythematous flux intercepted by the preparation applied to the skin. The main experimental factors and the limits of the method are discussed.

A new quantitative method in the evaluation of the stress effect on the vascular activity of the hand

by E.F.J. RING
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A simple method for the evaluation of the stress effect induced by cooling on the peripheric vascular activity is shown. In normal subjects the hand, following immersion in 20°C water for 1 min, regained the normal temperature within 10 mins. Many normal subjects show a reactive hyperthermia. In patients with vascular functional problems, such as **RAYNAUD**'s disease, a Δ t°C may be observed on the dorsal side of the hand, after cooling, an important decrease in higher temperature which lasts more than 10 mins. Infra-red T. or infrared radiometry permits a quantification of the thermic gradient of the hand. For a correct performance of the exam, the following conditions have to be observed: *a) constant environmental temperature* (20°C $\pm$ 0,5); β) *no smoke or alcohol intake* before the examination, and *presence in the room* for 15 mins; y) ideal *examination time* between 9 and 10 a.m., one h after breakfast; δ) the T. camera has to be put at a *fixed distance* from the subject. A constant temperature reference is utilized. In any case an analysing system of the T. images is at the Authors' disposal. Utilizing the method proposed by **COLLINS** et al (1974) the T. index (T.I.) is calculated in the area of interest in the hand T. Two areas were chosen: α) the area from *the wrist to the metacarpophalangeal joint*; β) from the *metacarpophalangeal joint to the finger extremities.*

$$\text{The formula T.I.} = \frac{\Delta t \cdot a}{A}$$

where A t = difference of temperature between a given isotherm and a constant one; a = the surface of the isotherm; A = the total surface of the T.

The reference temperature was of 24°C with a working range included between 24°C and 34°C and with T.I. ranging from 0 to 10. A negative value is obtained with a t°C<24°C. The thermic gradient before and after stress (reactive gradient) is obtained by the difference of the T.I. of the 2 areas of the hand. This method, in use for 3 yrs, allowed one to evaluate the influence of several parameters on the thermic gradient. It must be stressed that the gradient has no statistical relationship with the outside temperature both in winter and summer; the clima does not directly influence the dynamic method. The above considered method permits a quantitative evaluation of the narcotic vasodilator and β-blocking drug effects: it gave the same results as radiometry, but of a less onerous kind.

Thermal effusivity of skin: comparison between healthy skin and burnt skin

by A. DITTMAR, J, MARICHY, D. ORY and G. DELHOMME
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The thermal effusivity is a parameter which characterizes transitory heat transfers during contact, i.e. the aptitude of a medium to exchange heat with another medium; the thermal effusivity of a tissue is defined by

$$E = \sqrt{K.P.C.}$$

in which, K = thermal conductivity of the tissue; P = density; C = specific heat

The M.K.S. unit is = $J.\ S^{-1/2}.\ M^{-2}.\ °C^{-1}$

Thermal effusivity is well known in thermobiology as ((thermal inertia)); it depends on the structure and the nature of the different layers of the skin.

The measurements are made with a probe (14 mm in diameter) placed upon the surface of the skin; the speed of propagation of the thermal wave depends on the nature and the componants of these tissues. Results are recorded by a minicomputer, and a hard copy delivers the curves. The depth of explored tissues varies from 5 to 10 mm. Each measurement of burnt skin was compared if possible, with a measurement of the normal skin of the opposite symmetrical area (when possible). The shape and the amplitude of the effusivity spectrum depends upon the degree and the state of evolution of the burn. For the deep partial thiakness burn the effusivity of the superficial layers is low, and that of deep layers is high (2 or 3 times the normal values) indicating an inflammatory reaction during the first wk. During the second wk, the effusivity of the superficial layer is twice as low as the normal values; that is due to dry <<escharre>> (low water content) whereas the deep layer is close to normal values. For the full thickness burnt skin, during the first wk the effusivity of the superficial layers is 2 to 4 times low er than that of normal skin. The effusivity of the deep layer is close to normal value. During the healing phase, the effusivity of the superficial and deep layers tends to become normal.

Thermal conductivity and thermal conductance of skin: in vivo and vitro measurements

by A. DITTMAR, J. MARICHY, G. DELHOMME and J.L. GRIPPARI
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The thermal conductance of the skin represents the facility with which heat can pass through it; it depends upon the thickness and the nature of the componants of the skin, whereas thermal conductivity only depends upon the nature of the componants. For in vivo measurements it is difficult to know the exact thickness of the skin and, besides, the blood flow increases the apparent thermal conductance of skin. For these reasons, in vivo measurements are indicated in apparent conductivity; morever the equilibration of the probe is made with gels, the conductivity of which is known. The true thermal conductivity of the skin depends mainly upon its water content. The blood flow increases the effective thermal conductivity of skin. The relationship between skin blood flow and the increase of skin conductivity may be considered as linear. The in vivo measurements of healthy skin are between 0,25 and 0,45 W/m°C. The thermal conductivity of burnt skin (deep partial and full thickness burn) is equal or higher than that of healthy skin (0,3 to 0,6 W/m°C) due to its high water content. The thermal conductivity of the dry << escharre >> is twice as low than that of healthy skin. The in vivo and in vitro measurements have generally the same value if one considers the true thermal conductivity. The effective thermal conductivity of the deep partial burn remains high during the 3 wks after the bath (0,15 W/m°C). These results indicate a large increase in skin blood flow, whereas the full thickness burned skin shows a decrease of conductivity due to a low or nil blood flow.

Thermographic pattern of muscle work

by L. FOGHER
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The importance of the thermoregulation after a strain, is considered studying the T. differences in comparison with hemodynamic and thermometrical parameters. T. tests, performed on an inactive subject, in an overheated room show the immediate reaction of the skin process.

BREAST PATHOLOGY

Chairman: Dr. R. AMALRIC (Marseilles)

Prognostic value of thermography in breast cancer

by M. JAZIRI, A. SAADI, F. BROCHET and A. GHERAB
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A group of 150 patients with histologically proved breast cancer were studied in the Salah Azaiz Institute of Tunis and followed-up for 4 yrs. The aim was to establish if a thermally hot tumour produced a bad prognosis. There is a high percentage of inflammatory breast carcinemas in Tunisia (60%) with a 75% mortality rate after 4 yrs. These patients showed a hot T. in 80% of the cases. The clinically non inflammatory cancers are found in about 75% of the cases in T2 N1 stage and, on the contrary, the clinically inflammatory cancers are found T3 or T4 in the same percentage, and in more than 30% on the N2 or N3 stage.

The thermography and the practitioner

by M. ISMAEL and M. SCHMITT
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One hundred fifty general practioners and 150 gynecologists of the Rhone-Alpes district were questioned in order to establish the value of T. in breast disease; 37% of them answered. Seemingly, T. is chosen in high-risk patients and in the follow-up study of treated patients; it is usually performed in association with mammography, even though 50% of the practitioners sometimes prescribed T. alone. The general practitioners' knowledge of T. is very poor; 41% of them are not able to read a T., 50% do not know whether infra-red or contact T. is performed on their patients; 71% of the practitioners agree in considering T. useful in the detection of minimal breast cancers; finally 45% of them do not prescribe this examination, since they know little about its prognostic value. In general, T. is considered to be more useful by the general practitioners than by the gynecologists.

Combined diagnosis in breast cancers

by M. VASILIAD, I. CIOROIANU and A. MARIN
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Two hundred thirty-two cases of breast cancers studied at the Gynecological Section of the Military Hospital of Bucarest, during the period 1977-1979, were presented. In order to

establish a proper diagnosis the following methods have been 'applied: a) *clinical examination*; β) *T.* (with AGA apparatus-680 type); γ) *mammography*; δ) *citology*; ε) *biopsy*. The examined people were between 20-50 yrs old; in the teenagers no neoplasm was discovered. Twenty-nine of the examined people were in an advanced stage: the diagnosis was obvious at clinical examination. In total, 35 out of 80 biopsies made on the spot, were positive; 90% of breast cancer cases can be discovered by means of T. and mammography; the screening method was used in order to discover breast cancer at an early stage.

Thermography in the prognosis of breast cancer and its relationship with lymph nodes invasion

by A. BREMOND, M. SCHMITT, F. MICOLLE, M. ISMAEL and Y. ROCHET
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In 100 breast cancers the relation between the T. class and the lymph nodes invasion was considered. The 61.9% of lymph nodes invasion was present in classes IV and V, while in classes I to II there was only a 37.3%. This difference remained even considering the only breast cancers with diameter <2 cm (with the exception of the <<tin situ>> cancers); a 66.7% N+ in classes IV and V, and a 27.8% in classes I to III (but the examined series were short).

The role of telethermography in determining the radiation field in breast cancer cutaneous recurrences

by G. MUSTACCHI,① A. TORRETTA② and S. MILANI①
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Twelve patients with breast cancer cutaneous recurrences underwent T. The eventual hyperthermic area was delimited with stickers. This area was then considered by the Radiotherapist in treatment planning. To evaluate the method efficacy the following parameters were used: a) the percentage of cases in which an *hyperthermic area was remarkably larger* than the clinical observation; b) the percentage of cases in which a *post-surgical radiotherapy,* unpredictable without T. indication, was made; c) the percentage of cases in which the *T. result was essential in shaping the radiation field.* In 4 cases no hyperthermia was noted so that the only treatment used was surgery. In 8 cases hyperthermia was much larger than the clinical appearance of the recurrence, therefore, even if they were treated with wide excision, radiotherapy was always administered; in 4 of these cases, T. was essential in choosing the radiating field, because the configuration of the hyperthermic area was remarkably different from that which would be usually treated without T. help. This fact may be further investigated since T. is considered essential in order to plan the treatment of these cases, to identify patients treatable with surgery alone, to shape with « biological)) accuracy the radiation Geld; this mostly in nodular types, for which the electron beam therapy is the elective treatment.

Thermography, diaphanoscopy and doppler echography in the morphological and functional study of breast vascularisation

by SD. BIANCHI, G. GATTI, B. MECOZZI and W. LIBONI
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Arteriography - an invasive method - offers an often partial verification in vivo of the T. vascularisation. T. reveals arteries and veins in accordance with their heat and depth. Diaphanoscopy shows surface vessels corresponding to the usually venous subdermic pattern. **Doppler** echography determines the course, direction and rate of blood flow in vessels up to a depth of 2 cm. The association of these 3 methods provides a non-invasive means of studying breast vascularisation. 143 patients were studied this way (65 with T. and diaphanoscbpy only): 101 clinically healthy, 32 with benign forms, 11 with malignant neoplasias. The internal vascular peduncles were always detected by T. and echography, and the external peduncles were demonstrated with greater clarity by echography than by the other 2 methods. The median peduncle was revealed by echography only. Diaphanoscopy disclosed superficial veins that were often echographically silent (low flow), and appeared to have a narrow calibre (little heat) when examined by T. All 3 methods revealed an increase in the size and extent of the vascular pattern in the 11 cases of neoplasia, a finding that clearly requires investigation on a wider scale.

Radiotherapy of bone sarcomas and inf ra-red thermography

by C. ALTSCHULER, A. TRUFAUD, F. AMALRIC, J.M. SPITALIER and R. AMALRIC
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Nine out of 10 bone sarcomas are T. significant due to the good infra-red transmission of the bone; therefore T., although not pathognomic of the tumour, is useful for its treatment. The Authors have been using it for yrs in order to consider the target volume for irradiation and for the follow-up after radiotherapy. a) *The target volume* for indication will be the function of the surface and topography of the hot areas; this volume embraced also the hypervascularisation zone surrounding the hottest area. Therefore, the irradiation area comprised a much greater volume than that of the radiological images; since use of this technique the Authors noted no further recurrences at the edges of the irradiated area. b) The *T. follow-up,* after irradiation is of great value in evaluating the sterilisation or, on the contrary, the persistence of a tumoral evolution. The value of T. in 14 follow-up cases was excellent. a) 6/6 T. of *clinical sterilizations* lasting for 15 months to more than 5 yrs. were negative, while radiology was dubious in 4/6 cases; β) 7/7 T. of histologically confirmed *evolutions* were positive, while radiology was dubious in 2 cases, negative in 3. Finally, one false positive was registered: it was due to a pathologic fracture on an irradiated and treated bone. In conclusion T. may be considered the best follow-up method in irradiated bone sarcomas: it prevents useless amputations and allows to perform surgery on the bone.