

ISSN-1560-604X
Thermology international

Volume 14 (2004)
Number 1 (January)

Thermology

International

Literature survey: Thermology 2003
Thermography in arterial insufficiency

Published by the

Ludwig Boltzmann Research Institute
for Physical Diagnostics
Austrian Society of Thermology

This journal is indexed in
EMBASE/Excerpta Medica

THERMOLOGY INTERNATIONAL

Volume 14 (2004)

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Published by the

**Ludwig Boltzmann Research Institute for Physical Diagnostics
and the Austrian Society of Thermology**

Indexed in

Embase/Excerpta Medica

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Prof. DDr. Kurt Ammer

Ludwig Boltzmann Forschungsstelle
für Physikalische Diagnostik,
Hanuschkrankenhaus, Heinrich Collinstraße 30
A-1140 Wien, Österreich,
Tel: (43 1) 914-97-01 Fax: (43 1) 914-92-64
e-mail: KAmmer1950@aol.com

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Mitteilungen der Amerikanischen Akademie für Thermologie
der Britischen Assoziation für Thermographie
(Thermologie Gruppe);

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Luther B, Kreyer I, Dobi I. Die Anus-praeter- Thermographie als Methode zur Früherkennung vaskulärer Komplikationen nach Dünndarmtransplantation. *ThermoMed* 1990; 6: 115-17.

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Gautherie M, Haehnel P, Walter JM, Keith L. Long-Term assessment of Breast Cancer Risk by Liquid Crystal Thermal Imaging. In: Gautherie M, Albert E; editors. *Biomedical Thermology*. New York: Alan R. Liss Publ; 1982. 279-301.

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"Thermology international" erscheint 4 mal jährlich. Ein Jahresabonnement kostet 38 €, - ein Einzelheft 12- € plus Porto (4.50 € pro Heft außerhalb Österreichs).

Für Mitglieder der Österreichischen Gesellschaft für Thermologie, der Deutschen Gesellschaft für Thermologie und der Amerikanischen Akademie für Thermologie ist die Zeitschrift im Mitgliedsbeitrag inkludiert.

Literatur

(1) International Committee of Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. *Can. Med Assoc J* 1997;156:270-7.

(2) International Committee of Medical Journal Editors. Additional statements from the International Committee of Medical Journal Editors. *Can. Med Assoc J* 1997;156: 571-4.

Uhlen Verlag Wien,
Ingeborg Machyl, Fachzeitschriftenverlag
Gusenleithnergasse 28a/1, A-1140 Wien
Thermology international
ISSN-1560-604X

Internet: <http://www.uhlen.at/thermology-international>

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Instructions for authors

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Prof DDr. Kurt Ammer

Ludwig Boltzmann Forschungsstelle für
Physikalische Diagnostik, Hanuschkrankenhaus
Heinrich Collinstraße 30 A-1140 Wien, Österreich,
Phone: (43 1) 914-97-01 Fax:(43 1) 914-92-64
Personal e-mail:KAmmer1950@aol.com

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Manuscripts should follow the recommendations of the International Committee of Medical Journal editors (ICMJE) (1) and should be organized as follows: Introduction, methods, results, discussion, acknowledgements, references. A short abstract in English and, if possible, German (translation will be offered) should head the manuscript. Following the abstract, up to 5 key-words should characterize the paper.

Tables, Figures and Legends for illustrations should appear each on an extra sheet of paper.

Submission on computer discs with name of the used system is encouraged. A print of the disc content should be enclosed.

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Luther B, Kreyer I, Dobi I. Die Anus-praeter-Thermographie als Methode zur Früherkennung vaskulärer Komplikationen nach Dünndarmtransplantation. *ThermoMed* 1990; 6: 115-7.

Chapter in a book

Gautherie M, Haehnel P, Walter JM, Keith L. Long-Term assessment of Breast Cancer Risk by Liquid Crystal Thermal Imaging. In: Gautherie M, Albert E, editors. *Biomedical Thermology*. New York Alan R. Liss Publ; 1982. p. 279-301.

Before publication proof prints will be mailed to the main author for corrections. Each author will receive 20 free copies of the reprint.

The journal "Thermology international" (formerly "European Journal of Thermology") is published four times/year. Annual Subscription rate is 38.- €, a single copy costs 12.- € plus mailing costs (4.50 €/copy; outside Austria).

The journal is supplied free of charge to members of the American Academy of Thermology, the Austrian Society of Thermology and also to members of the German Society of Thermology.

References:

(1) International Committee of Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. *Can. Med Assoc J* 1997;156:270-7.

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Uhlen Verlag Wien,
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Gusenleithnergasse 28a/1, A-1140 Wien
Thermology international
ISSN-1560-604X

Internet: <http://www.uhlen.at/thermology-international>

Thermology 2003 – a computer-assisted literature survey with a focus on non medical applications of thermal imaging

Kurt Ammer

Ludwig Boltzmann Research Institute for Physical Diagnostics (Director: Prof. O. Rathkolb, MD), Vienna; Austria

Medical Imaging Group, School of Computing, University of Glamorgan, Pontypridd, U.K.

SUMMARY

This literature survey is based on publications with the keywords “thermography” or “thermology” or “thermal imaging” or “thermometry” or “temperature measurements” listed in the databases Medline, Embase, HighWire and Science Direct between 1.1.2003 and 31.12.2003. This has resulted in 1087 references, which is the highest number of references since this annual literature survey was first published. Thermography was the main subject of 271 papers, but a number of other methods for temperature measurement are used in clinical medicine. Papers dealing with non medical applications of thermal imaging were separately analysed. Non destructive testing and quality control in the pharmaceutical industry were the most frequently found non medical applications.

Key words: Temperature measurement, thermography, literature search, Biophysics

THERMOLOGIE 2003- EINE COMPUTER GESTÜTZTE LITERATURÜBERSICHT MIT EINEM SCHWERPUNKT AUF NICHT-MEDIZINISCHE ANWENDUNGEN DER THERMOGRAPHIE.

Diese Literaturübersicht basiert auf Publikationen, die mit den Schlüsselwörtern “thermography” oder “thermology” oder “thermal imaging” oder “thermometry” oder “temperature measurements” in den Datenbanken Medline, Embase, HighWire und Science Direct im Zeitraum zwischen 1.1.2003 und 31.12.2003 gefunden wurden. Diese resultierte in 1087 Literaturziten, der größten Zahl von Zitaten seitdem dieser jährliche Literaturüberblick veröffentlicht wird. Die Thermographie war das Thema von insgesamt 271 Publikationen, jedoch werden auch andere Methoden zur Temperaturmessung in der klinischen Medizin verwendet. Arbeiten, die den nicht medizinischen Einsatz der Thermographie behandelten, wurden separat analysiert. Die zerstörungsfreie Materialprüfung und die Qualitätskontrolle in der pharmazeutischen Industrie waren die am häufigsten genannten Anwendungen.

Schlüsselwörter: Temperaturmessung, Thermographie, Literatursuche, Biophysik

Thermology international 2004, 14: 5-36

Introduction

This 2003 literature survey of papers dedicated to thermology, will provide the reader with a broad overview of the current role of temperature measurements in medicine and biology. An additional focus of this literature analysis, are publications on non-medical thermal imaging. The database of this report has been constructed from the results of a search in the medical databases Medline, Embase and the database of the internet publisher HighWire. Unlike the previous annual surveys, abstracts from conferences have not been included in this database report.

Methods

A literature search was performed in the medical databases Medline, Embase, and Highwire using the following keywords: “thermography”, “thermology”, “thermal imaging”, “thermometry” or “temperature measurement”. Finally, all science journals from the database Science Direct were searched using the keywords “thermography” or “thermal imaging” to find additional publications outside of medicine and biology. The time period selected was between 01.01.2003 and 31.12.2003. The lists of results from Medline, Embase, Highwire and Science Direct were checked for any duplication and were excluded. The database was analysed to show the origin of authors, the language and journal of publication and issue number of the publication.

Papers were allocated with respect to the topic of the publication in medical and non medical publications. Non medical papers were further classified into basic sciences, applied sciences and biology

Results

Publications from Medline, Embase and Highwire

A total of 1087 publications, not previously reviewed, were found from the three databases, which yielded 167 results in Medline, 607 (43 removed), and 118 (51 removed) in HighWire. The search in Science Direct found 400 papers. After removal of pre-term publications for 2004, there were 297 remaining and after checking for duplication, 281 publications were added to the database of references for this paper. 271 publications (164 papers more than last year), appeared with the key words “thermography” or “thermal imaging” indicating a continuous increase of use of the thermal imaging technique. All other publications were related to temperature measurement.

English continues to be the predominant language for publication (94,7% of publications), followed by German (1,7%), Spanish (0,8%), Japanese (0,6%), Russian (0,6%), French (0,5%), Chinese (0,4%), Danish (0,2%), Portuguese (0,2%), Italian (0,1%), Hebrew (0,1%), Norwegian (0,1%), Polish (0,1%) and Turkish (0,1%).

605 institutes in 43 countries (Australia 2; Austria 21; Belarus 2, Belgium 7; Benin 3, Brazil 9, Canada 24; China 19, Czech Republic 2, Denmark 5; Egypt 3, Estonia 1, Finland 5, France 20; Germany 47; Greece 4; Hungary 2, India 24, Iran 1, Israel 19; Italy 16; Japan 61, Mexico 1, Netherlands 18; Nigeria 2; Norway 5; Poland 10; Portugal 4; Romania 1, Russian Federation 10; Singapore 6; Slovakia 2, Slovenia 1, South Africa 3; South Korea 15; Spain 18; Sweden 5; Switzerland 7; Taiwan 15; Trinidad 1, Turkey 11, United Kingdom 49; United States 179) were involved in temperature measurements.

In total, 541 journals published papers on temperature related matters. The highest number of publications, i.e. 29, were found in *The Journal of Petrology*. 19 papers related to temperature appeared in the *International Journal of Systematic & Evolutionary Microbiology*, 17 papers were published in *Journal of Nuclear materials*, 12 in *Fusion, Engineering and Design*, and 13 in *Biomacromolecules*. Both, the *International Journal of Heat and Mass Transfer* and *Thermology International* dedicated 11 publications to the issue of this survey. 5 journals published 10 papers related to temperature measurement and 3 other journals contributed 9 publications to this topic. 21 journals published within the given time frame between 4 and 7 papers on temperature measurement. 39 journals were found that had published 3 papers, and 74 journals published two papers on temperature matters.

67 publications reported clinical trials which were performed either in a controlled (99, 172, 183, 273, 296, 311, 366, 418, 429, 433, 451, 484, 507, 564, 573, 584, 611, 671, 683, 745, 780, 807, 848, 867, 901, 1046, 1077) or randomised controlled study design (95, 203, 234, 344, 416, 420, 455, 461, 550, 617, 682, 690, 746, 774, 791, 835, 888, 950, 1010). 20 papers were dedicated to evaluation studies of equipment (4, 105, 136, 162, 225, 296, 313, 332, 334, 391, 530, 589, 618, 710, 720, 789, 857, 874, 1053, 1084). The technology of infrared measurement devices was discussed in 22 papers (33, 253, 262, 263, 275, 288, 401, 462, 527, 583, 588, 601, 666, 680, 742, 801, 829, 850, 942, 1062, 1076, 1084) and infrared spectroscopy was the topic of 13 other papers (265, 312, 371, 540, 567, 575, 576, 809, 827, 904, 932, 934, 996).

In 34 animal experiments (115, 144, 163, 169, 185, 237, 249, 338, 355, 406, 410, 419, 434, 490, 499, 597, 641, 647, 679, 680, 699, 740, 768, 773, 794, 798, 821, 839, 906, 974, 1016, 1021, 1027, 1057) temperature measurements were performed. 36 review papers (15, 26, 70, 95, 102, 175, 223, 236, 252, 255, 281, 313, 341, 342, 378, 279, 438, 466, 540, 544, 578, 596, 613, 781, 790, 793, 813, 834, 865, 969, 956, 1005, 1034, 1053, 1077, 1086) were related to medicine and 9 reviews to biology (266, 271, 299, 334, 453, 560, 804, 810, 1039). Applied sciences was the topic of 16 other reviews (58, 60, 231, 402, 408, 454, 523, 565, 668, 725, 751, 762, 873, 969, 1009, 1065). 5 editorials (25, 57, 503, 805, 828) and 25 letters or comments (51, 122, 267, 285, 329, 340, 376, 380, 389, 465, 580, 624, 657, 659, 691, 700, 744, 760, 767, 889, 905, 973, 982, 1029, 1071) also dealt with temperature measurement.

In total 4210 authors were found. Of these, 161 authors appeared with two papers, 26 authors with three papers. 11

authors published 4 papers and 5 others had 5 contributions to temperature measurement. Each of three Greek authors, interested in the assessment of intravascular temperature changes, had 6 publications.

Medical publications

Medline and Embase allocated their listed citations to distinct fields of medicine. For HighWire the appropriate allocations were performed by the author.

The allocations for basic medical sciences were in the following fields: Anatomy and Histology (66, 213, 225, 249, 321, 391, 566, 596, 613, 624, 810, 826, 883, 1027), General Pathology and Histopathology (169, 175, 234, 242, 249, 306, 325, 616, 705, 715, 724, 773, 806, 883, 906, 940, 1005, 1027, 1051), Genetics and Microbiology (21, 64, 87, 129, 143, 149, 157, 211, 230, 250, 256, 271, 274, 295, 333, 334, 352, 361, 390, 398, 425, 433, 464, 501, 510, 511, 535, 538, 547, 554, 560, 562, 572, 573, 591, 606, 639, 643, 674, 684, 695, 751, 752, 755, 780, 794, 799, 803, 804, 813, 825, 831, 859, 872, 911, 925, 926, 947, 961, 972, 979, 1006, 1008, 1039, 1054, 1061, 1069, 1074), Physiology (46, 47, 57, 70, 99, 107, 115, 118, 129, 130, 131, 180, 185, 231, 323, 337, 347, 375, 395, 406, 428, 430, 466, 473, 493, 511, 519, 522, 552, 590, 600, 602, 624, 630, 649, 652, 662, 675, 678, 696, 699, 715, 724, 789, 834, 839, 842, 861, 869, 888, 907, 928, 929, 931, 953, 965, 993, 1005, 1085).

Cardiovascular Diseases and Cardiovascular Surgery (44, 86, 102, 142, 147, 162, 175, 234, 236, 237, 238, 242, 245, 249, 296, 306, 504, 519, 596, 597, 600, 667, 679, 690, 726, 789, 826, 841, 886, 896, 902, 903, 904, 910, 937, 964, 966, 985, 997, 1005, 1026, 1040, 1085), Anaesthesiology (12, 70, 73, 122, 145, 162, 193, 222, 284, 285, 301, 313, 333, 340, 355, 374, 376, 393, 396, 414, 420, 429, 455, 461, 484, 493, 499, 558, 602, 617, 644, 645, 690, 706, 716, 726, 760, 819, 905, 973, 1010, 1053) and Radiology (71, 76, 141, 245, 317, 325, 342, 458, 490, 571, 585, 654, 739, 740, 769, 883, 902, 919, 941, 992, 1004, 1007, 1044, 1082) were the most frequent allocated specialities of clinical medicine. Pediatrics and Pediatric Surgery (80, 85, 139, 146, 183, 284, 302, 419, 429, 442, 466, 600, 660, 791, 808, 848, 940, 988, 1013, 1038), Cancer (15, 49, 97, 324, 325, 356, 373, 377, 378, 395, 411, 444, 448, 451, 529, 530, 556, 568, 617, 659, 659, 663, 691, 768, 769, 900, 971, 987, 989, 1045, 1051, 1086), Neurology and Neurosurgery (66, 99, 163, 192, 273, 292, 294, 301, 329, 391, 420, 457, 469, 483, 613, 680, 693, 834, 836, 882, 979) and were the next in frequency of allocation.

Obstetrics, Gynaecology and Breast Disease (268, 389, 444, 556, 661, 691, 1022, 1045, 1050, 1051, 1086), Urology and Nephrology (248, 316, 317, 394, 395, 294, 503, 721, 732, 889, 919, 989), Endocrinology (1, 130, 131, 222, 359, 364, 533, 662, 683, 770, 824, 942), Public Health, Social Medicine and Epidemiology (90, 139, 162, 172, 221, 230, 428, 472, 572, 614, 669, 674, 807, 950, 1046), Ophthalmology (125, 254, 286, 399, 501, 396, 513, 548, 647, 653, 756, 867, 927), Dental Medicine (114, 307, 486, 514, 581, 582, 618, 913, 949, 1034), General Surgery (230, 380, 389, 395, 409, 558, 654, 881, 941, 1004), Physical Medicine and Rehabilitation (6, 8, 20, 226, 227, 698, 700, 745, 811, 817, 849), and Arthritis and Rheumatism (67, 330, 342, 358, 622, 623, 692, 739, 745, 806, 983) were other medical fields related to temperature measurements.

Nine or >9 papers were found in: Orthopedic Surgery (25, 88, 108, 333, 380, 497, 550, 743), Angiology (78, 172, 446, 546, 578, 658, 684, 1082), Gastroenterology (115, 277, 900), Otorhinolaryngology (50, 427, 508, 536, 574, 735, 736, 905), Dermatology and Venereology (6, 50, 330, 456, 684, 701, 914), Chest Diseases, Thoracic Surgery and Tuberculosis (693, 743, 1077), Gerontology and Geriatrics (99, 344, 504, 572) and Occupational Health and Industrial Medicine (168, 353, 508, 512, 924).

Non medical publications

Basic Sciences

The predominant fields were Physics (29, 38, 61, 96, 109, 161, 196, 199, 216, 229, 259, 270, 298, 365, 401, 448, 528, 530, 588, 601, 607, 672, 717, 828, 829, 880, 881, 890, 995, 1047, 1084, 1086), Biophysics (8, 26, 49, 171, 225, 529, 652, 711, 811, 891, 834, 992), Chemistry (4, 17, 54, 119, 154, 167, 181, 282, 283, 354, 357, 408, 426, 495, 588, 567, 712, 713, 762, 809, 878, 932, 990, 1020, 1056) and Biochemistry (62, 93, 116, 143, 152, 166, 171, 190, 204, 211, 244, 246, 248, 274, 305, 334, 390, 425, 459, 463, 464, 471, 505, 616, 686, 687, 694, 702, 773, 825, 870, 908, 922, 972, 1063, 1064, 1079). 33 papers were related to Geology and Petrology (2, 23, 63, 103, 128, 137, 165, 194, 198, 201, 260, 282, 283, 297, 314, 315, 439, 481, 516, 532, 545, 608, 609, 612, 655, 734, 737, 746, 812, 822, 930, 955, 1032).

Pharmacology had an allocation of 49 papers (15, 70, 75, 98, 102, 124, 163, 166, 169, 180, 217, 261, 338, 344, 355, 374, 378, 414, 416, 434, 446, 452, 455, 461, 466, 484, 488, 641, 649, 675, 694, 699, 709, 716, 732, 744, 758, 773, 774, 779, 813, 820, 821, 865, 904, 971, 1046, 1055, 1085) and Pharmaceutics had 36 papers (81, 97, 136, 206, 217, 233, 246, 383, 392, 423, 434, 477, 501, 540, 541, 553, 554, 560, 575, 576, 577, 591, 640, 663, 673, 677, 766, 787, 796, 819, 827, 881, 918, 927, 969, 1001).

Applied Sciences

Engineering, Bioengineering and Medical Instrumentation had the highest number of hits. Various applications of lasers were discussed in 51 papers (6, 7, 8, 47, 71, 189, 286, 290, 306, 307, 371, 389, 391, 409, 427, 486, 513, 514, 527, 618, 647, 663, 722, 727, 756, 768, 769, 869, 881, 913, 921, 949, 1004, 1027, 1034, 1057, 1082) including laser Doppler flowmetry and imaging (1, 107, 187, 340, 406, 493, 546, 692, 693, 703, 777, 836, 914, 1057). Radiofrequencies in the short and microwave range was the topic of 37 papers (4, 28, 141, 144, 152, 243, 245, 278, 356, 373, 378, 393, 409, 422, 458, 523, 529, 530, 571, 585, 628, 629, 632, 654, 705, 770, 776, 789, 811, 826, 860, 869, 898, 906, 948, 1029, 1044) and papers were published ultrasound (200, 49, 102, 145, 155, 169, 213, 226, 227, 325, 421, 448, 556, 596, 602, 607, 618, 711, 739, 777, 860, 869, 880, 883, 904, 941, 992, 1005).

Environmental Health and Pollution Control (207, 218, 280, 304, 353, 412, 579, 685, 741, 852, 857, 887, 995, 1031, 1065) and Non-Destructive-Testing (19, 56, 58, 59, 60, 61, 91, 100, 109, 120, 186, 543, 599, 625, 838, 846, 1025) were also addressed.

Biology

Botany and Crop Science (25, 46, 55, 64, 208, 227, 312, 326, 376, 468, 909, 1064), Zoology (94, 116, 134, 152, 185, 198,

215, 223, 224, 343, 374, 430, 620, 715, 810, 847, 893, 894, 836, 939, 944) and Veterinary Medicine (31, 38, 40, 72, 79, 105, 267, 396, 519, 534, 560, 604, 636, 749) were the main fields of application of temperature measurement in biology.

Thermal Imaging outside of medicine

Thermal imaging was applied in various fields outside of medicine and biology. The predominant applications were for non destructive testing (58, 59, 60, 61, 91, 186, 599, 853, 994), quality control in pharmaceuticals (206, 233, 392, 423, 541, 575, 576, 640, 663, 827, 1001, 1076) and catalysis (92, 494, 569, 784, 785, 863, 977). Infrared imaging was also used in material science (16, 56, 618, 1023), physical chemistry (702, 809, 1028) and nanotechnology (179, 545). The technique was used for measurements of heat exchange (123, 403, 621, 748), environmental engineering and pollution control (218, 565, 592, 991), fusion engineering and design (262, 269, 753) and for targeting focused ultrasound (711).

Discussion

The number of publications found for this survey is the highest since this annual literature survey was first published. This may be due to the fact that the databases Embase and Science Direct were included in this years' search, resulting in increased numbers of results in the fields of basic and applied sciences.

There is an increased reported use of thermal imaging in the fields outside medicine such as botany, zoology, chemistry, pharmaceuticals and non destructive testing. The most frequently published topic in clinical medicine was intravascular temperature measurement or angioscopic thermography, respectively. As with last year's survey, cardiovascular medicine, neurology, paediatrics, radiology and anaesthesiology remained the main fields of medical temperature measurements. Thermal imaging based diagnosis of breast disease continued to be an important task. This is supported by the fact, that a top ranked journal in radiology has published a paper on thermographic assisted diagnosis of breast lesions, which has initiated much discussion.

The influence of European research is increasing in all fields, and the number of publications from the United States is again reduced compared to previous surveys. 29,5% of institutes researching in temperature related matters are situated in the United States, but 41,7% of all institutes are located in Europe. The remaining research facilities are in Japan, China, Israel, South Korea and Taiwan. Less than 5% of temperature related research has originated from countries in Africa, South America and the Middle East.

In conclusion, this literature survey for 2003 has demonstrated a continuing high interest in temperature measurement techniques, and the technique of thermal imaging has been increasingly used in fields outside of medicine and biology. Although basic sciences and applied sciences such as engineering are the predominant applications, temperature measurements in clinical medicine remains an important topic.

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Address for correspondence

Prof Kurt Ammer MD, Ph.D

Ludwig Boltzmann Research Institute for Physical Diagnostics, Hanuschkrankenhaus, Heinrich Collinstr. 30, A-1140 Vienna, Austria, email: lbfphys@a1.net

(Manuscript recieved on 10.01.2004, revision accepted on 20.01.2004)

Citations

Please cite this paper as

Ammer K. Thermology 2003 - – a computer-assisted literature survey with a focus on non medical applications of thermal imaging. Thermology International. 2004; 14(1):5-36

This paper was cited by

1. Ammer K. Thermology 2004- a computer-assisted literature search. Thermol int 2005, 15(1): 5-37
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Thermographic assessment of chronic arterial insufficiency of the lower extremities treated with glucosaminoglycans

Maciej Pietruszka, Janusz Domaniecki, Leszek Gburzyński

Department of Surgery, Air Force Institute of Aviation Medicine(Head: Prof Janusz Domaniecki, MD, PhD), Warsaw, Poland

SUMMARY

Thermography is the examination or recording of an image of the variations in surface temperatures of an object by detecting the infrared radiation emitted by this object. Its high sensitivity enables the early detection of ischaemic disorders and the monitoring of therapy dynamics and its outcome. This study was performed to evaluate the use of thermography in the assessment of peripheral arterial occlusive disease, and monitoring of patient treatment. The study included two groups of 20 patients. Group I: 20 active pilots from military helicopters, following regular medical examination by the Central Aviation-Medical Commission. Group II: 20 patients with chronic ischemia of the lower extremities. Patients treated with sulodexin have also been studied prior to, and after therapy. In all patients thermography and Doppler ultrasound were performed, and the rate of arterial pressure at the ankle to that in brachial artery (ABI) measured. In the clinical group of patients thermography revealed a decrease in mean lower leg temperature by 1.1–1.4° C, in comparison with the mean temperature of the same area in healthy pilots. Immediately after therapy, the mean temperature increased by 0.6–0.8° C. ABI before the treatment was decreased by 0.18–0.87, and after therapy increased by 0.05–0.25°C (mean 0.15) in comparison with the initial values.

Clinical examination has shown a marked prolongation of the distance the patients were able to walk without claudication. Thermography is a valuable additional diagnostic tool in the assessment of peripheral blood flow and may be used to monitor the outcome of the treatment.

Key Words: Thermal imaging, sulodexin, peripheral arterial occlusive disease, ischemia

THERMOGRAPHISCHE BEURTEILUNG DER CHRONISCHEN ARTERIELLEN INSUFFIZIENZ DER UNTEREN EXTREMITÄTEN NACH DER BEHANDLUNG MIT GLYKOSAMINOGLANEN

Die Thermographie ist eine Untersuchung bzw. die bildhafte Darstellung der Veränderung der Oberflächentemperatur eines Objektes, die auf der abgestrahlten Infrarotstrahlung dieses Objektes basiert. Die hohe Sensitivität der Thermographie erlaubt eine frühzeitige Entdeckung ischämischer Erkrankungen, ihre therapeutische Überwachung und Ergebnis. Die vorliegende Studie hatte das Ziel, die Brauchbarkeit der Thermographie zur Beurteilung der peripheren arteriellen Verschlusskrankheit der Überwachung der Behandlung zu überprüfen. In die Untersuchung wurden zwei Gruppen von Patienten aufgenommen: Gruppe I: 20 aktive Piloten von Militärhubschraubern, die in der Medizinischen Luftfahrtsbehörde die regelmäßige Beurteilung ihres Gesundheitszustandes vornehmen hatten lassen; Gruppe 2: 20 Patienten mit chronischen Durchblutungsstörungen der unteren Extremitäten. Die Patienten wurden vor und nach Behandlung mit Sulodexin untersucht. Dabei wurde bei allen Patienten eine Thermographie, eine Ultraschall-Doppler - Untersuchung durchgeführt und das Verhältnis des arteriellen Blutdrucks an den Arterien des Armes und am Knöchel (Arm-Knöchel-Index) bestimmt. Die mittlere Hauttemperatur der unteren Extremität fand sich bei den Patienten um 1.1–1.4° C geringer als bei den gesunden Piloten. Unmittelbar nach Therapie kam es bei den Patienten zu einem durchschnittlichen Temperaturanstieg von 0.6–0.8° C. Der Arm-Knöchel-Index war vor der Behandlung auf 0.18–0.87 vermindert. Nach Therapie stieg er um 0.05–0.25 (durchschnittlich 0.15) an.

In der klinischen Beurteilung zeigte sich eine Verlängerung der Claudicatio freien Gehstrecke. Die Thermographie ist eine wertvolle Zusatzmethode in der Diagnostik der peripheren Durchblutung und kann zur Beurteilung des Therapieerfolges verwendet werden.

Schlüsselwörter: Thermographie, Sulodexin, periphere arterielle Verschlusskrankheit, Ischämie

Thermology international 2004, 14(1): 37-40

Introduction

Vascular diseases are one of the basic medical problems in the twenty first century. Peripheral arterial insufficiency of the lower extremities is the most frequent cause of arterial occlusion or stenosis, after ischaemic heart disease (about 2.5–5% of the population over 55 years of age). Atherosclerosis of the arteries in the lower extremities is responsible for 85–95% of chronic occlusions. The remainder is due to Buerger's disease (1.3–3%), and rare vascular diseases, vascular symptoms of collagenoses, pressure syn-

dromes, polyarteritis nodosa, fibromuscular hypertrophy (3,4). The increasing rate of disease due to arterial occlusion and high mortality make diagnosis, prophylaxis, and therapy a serious medical and social problem. Early detection of the disease is difficult as there are no obvious symptoms. Appropriate prophylactic measures if introduced early could delay development of the disease. In recent years, research has been directed to developing non-invasive diagnostic techniques. One such technique is infra red thermography.

It records surface body temperature by measuring emitted infrared radiation. Thermography is used to measure the distribution of temperature on the surface of skin or adjacent tissues (5,6).

This study was performed to evaluate the usefulness of thermography in the diagnosis of the peripheral arterial insufficiency, and in treatment monitoring in cases of chronic ischaemia of the lower extremities.

Methods

Forty individuals have been studied, in two groups. Group I: 20 occupationally active, clinically healthy pilots.

Group II: 20 patients classified to sulodexide therapy; staging of the disease (according to Fontain's classification) has been the following: stage II – 15 patients, stage III – remaining 5 patients.

Patients have been given Vessel Due F (sulodexide) in a daily dose of 600 LSU in the intravenous infusions, every day for 21 days, followed by oral therapy with a dose of 250 LSU twice daily for 71 days.

During treatment, the following parameters have been assessed: rest pain in a subjective scale from 0 to 5, daily use of analgesics, and ulcer healing.

Prior to, and after intravenous phase of therapy, the following parameters were assessed:

- perfusion of the lower extremities: color, necrosis extension, temperature, pulse;
- rest pain (subjective), daily analgesic use;
- distance of intermittent claudication;
- temperature distribution, basing on the computer-assisted analysis of recorded thermograms (AGEMA 900);
- Doppler ultrasound;
- ABI index.

Thermographic system Agema Thermovision 900 with scanner SW with a 20° objective has been used to record temperature. Infrared radiation was recorded under constant conditions ($T_{\text{ambient}} = 26^{\circ}\text{C}$, $\text{RH} = 50\%$, and the objective placed 140 cm from examined surface) according to mathematical model LOWTRAN B for emission index 0.98. The software system Erika 3.11 was used for the analysis of recorded thermograms. Temperature values (minimum, maximum, and mean for the selected area) were calculated and areas of the selected isotherms have been compared.

Ultrasound examination was performed with an American ACCUSON-5 device. ABI was measured with VASOCAN, from the UK.

Results

In pilots, the Doppler ultrasound images did not reveal any morphological disorders in the large arteries such as: abdominal aorta, common and external iliac arteries, deep and superficial femoral, popliteal, anterior and posterior tibial, and dorsal arteries of the foot. The velocity and character of blood flow in the examined pilots was within normal values (+++).

Doppler ultrasound examination performed prior to, and immediately after therapy completion in group II showed multilevel changes in the arterial system of the lower extremities. Atherosclerotic disorders of variable extension and number were found in the abdominal aorta, the common and external iliac arteries, deep and superficial femoral arteries, popliteal, anterior and posterior tibial, and dorsal arteries of the foot. These pathologies resulted in marked hemodynamic disturbances in peripheral blood flow. Both the character and velocity of the blood flow were affected. Blood flow was decelerated in stenotic segments accompanied by spectrum widening, dependent on the degree of vessel stenosis and its diameter.

In group I the mean ABI on the right extremity was 1.17, and on the left it was 1.16.

ABI values in group II were statistically significant prior to, and immediately after treatment according to the Student T test, with a probability index $p < 0,05$. Prior to treatment the mean value for the right extremity was 0.63, while for the left extremity – 0.65. After therapy, these indices were 0.75 and 0.82, respectively.

In the 20 pilots in group I thermograms of the anterior crus and foot surfaces were analyzed. The calculated mean, maximum and minimum temperatures are given in Table I.

The results of thermographic measurements in group II subjects prior to intravenous treatment with sulodexide are shown in Table II (maximum, minimum, and mean temperatures).

Table I.

Distribution of mean temperatures on the crus and feet surfaces (group I)

Temperature (in $^{\circ}\text{C}$)	Minimum	Maximum	Mean	$\pm\text{SD}$
Right crus	29.00	35.10	31.18	± 1.45
Right foot	24.90	33.80	28.88	± 2.38
Right lower leg	24.90	35.10	30.03	± 1.91
Left crus	28.60	35.20	31.21	± 1.46
Left feet	24.40	35.20	30.04	± 2.31
Left lower leg	24.40	35.20	30.04	± 1.88

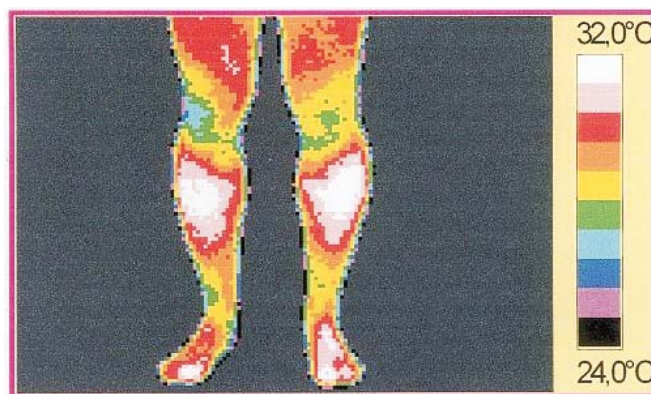


Figure 1
Thermogram of the randomly selected pilot of group I.

The results of thermographic measurements in group II subjects after the completion of intravenous treatment with sulodexide are shown in Table III (minimum, maximum, and mean temperatures).

Discussion

Chronic ischaemia of the lower extremities is an important clinical and social problem. Reconstructive surgery produces a rapid clinical improvement manifested by pain relief, disappearance of the intermittent claudication, ulcer healing, and marked improvement in blood flow velocity. In case of patients not selected for surgery (multi level disease, peripheral arterial insufficiency or poor general health status) medical treatment is a solution.

In the medical treatment of chronic peripheral occlusive disease, different preparations of prostaglandin, glucosaminoglycans, and pentoxifylline are used (7,8,9).

In this study the results of Doppler ultrasound examination of the great arterial vessels of the lower extremities in the group of healthy pilots did not reveal any disorders of blood flow; both in velocity and character of the blood flow which was normal. ABI values were within normal range 0.9 – 1.20. Mean ABI values on the left extremities 1.16 differed from those on the right extremities by 0.01.

Thermographic measurements of the temperature on the right anterior crus and foot surfaces were used to calculate mean temperature (table 1). Thermographic measurements, Doppler ultrasound, and ABI were all normal in the group of healthy pilots.

In the group of patients with chronic occlusive disease Doppler ultrasound has shown multilevel atheromatic disorders in the arterial system of the lower extremities. Before treatment, ABI values were 0.12 – 1.10, on the right leg

Table II.

Distribution of mean temperatures on the crus and feet surfaces (group II before sulodexide therapy)

Temperature (in °C)	Minimum	Maximum	Mean	±SD
Right crus	27.40	31.30	29.93	± 0.84
Right foot	24.20	30.80	27.37	± 2.15
Right lower leg	24.20	31.30	28.65	± 1.49
Left crus	27.10	31.30	30.00	± 1.05
Left feet	22.90	31.40	27.81	± 2.80
Left lower leg	22.90	31.40	28.90	± 1.92

Figure 2.

Thermograms of the randomly selected patient of group II prior to and after the treatment.

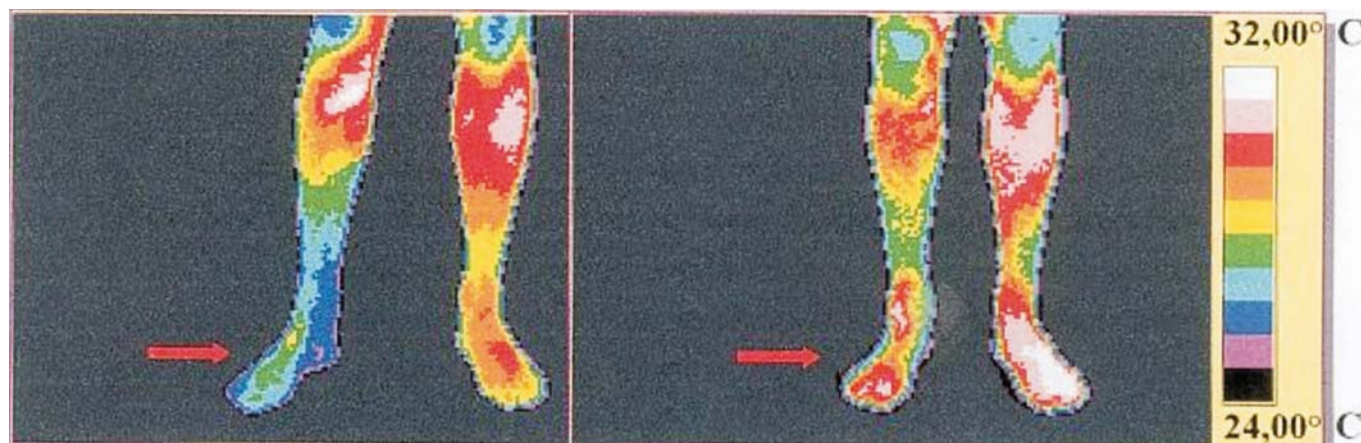


Table III.

Distribution of mean temperatures on the crus and feet surfaces (group II after sulodexide therapy)

Temperature (in °C)	Minimum	Maximum	Mean	±SD
Right crus	27.50	31.60	30.38	± 0.93
Right foot	25.10	30.50	28.19	± 1.66
Right lower leg	25.10	31.60	29.28	± 1.29
Left crus	27.40	31.70	30.47	± 0.98
Left feet	24.40	31.10	28.85	± 2.06
Left lower leg	24.40	31.70	29.66	± 1.52

0.63, and 0.65 on the left leg. In comparison with subjects of group I the difference was 0.53 and 0.50, respectively.

Thermographic measurements performed in patients of group II were used to calculate mean temperature in the crus and foot areas. The difference in comparison with the group of healthy pilots has been 1.29° C and 1.05° C, respectively. As far as the maximum mean temperature is concerned, the difference in comparison with group I was 3.45° C and 3.18° C, respectively, whereas the difference in minimum temperature was 1.15° C and 1.28° C, respectively.

In the group of patients elected to medical treatment, staging of the disease (according to Fontain's classification) was as follows: stage II – 15 patients, stage III – remaining 5 patients. The distance of the intermittent claudication was 100 – 200 meters, mean around 150 meters. Doppler ultrasound showed multilevel changes affecting blood flow.

The calculated ABI before the treatment was 0.12 – 0.89. Its mean value for the right leg was 0.63 and left leg – 0.64. In comparison with group I (healthy pilots), the difference was 0.53 for the right, and 0.51 for the left leg.

Mean temperature was 28.65° C (± 1.49) for the right and 28.90° C (± 1.92) for the left leg, respectively. Respective differences in relation to the group I were 1.38° C and 1.04° C. The differences in mean value of maximum temperatures were 3.40° C and 3.20° C, respectively. The respective differences in the values of mean and minimum temperature were 1.15° C and 1.50° C.

Medical treatment relieved rest pain in 5 patients, whereas in the remaining 15 the distance of intermittent claudication increased from 200 meters to 400 meters (mean: 230 meters). Doppler ultrasound did not show an improvement in blood flow. After the treatment, the value of ABI increased to 0.75 on the right side and to 0.85 on the left side (mean: by 0.11 and 0.21, respectively, in comparison with the initial values). Respective differences in relation with group I were 0.41 and 0.30.

Thermographic measurements indicated an increase in mean temperature of the right lower leg by about 0.63° C, and the left lower leg by 0.76° C. In case of a mean value of maximum temperature this increase was noted on the left lower leg only, and was 0.25° C. An increase in the mean value of minimum temperature was 0.45° C and 0.90° C on the right and left side, respectively. A difference in comparison with the values in a group of healthy pilots was 0.55° C and 0.38, respectively. The mean value of maximum temperature was lower than that in the healthy pilots by 2.55° C on the right, and by 3.15° C in the left side. Differences in a

mean minimum temperature were 0.70° C and 0.60° C, respectively.

Conclusions

1. Thermography is a sensitive, non-invasive technique evaluating perfusion disorders in the lower extremities. Patients with lower limb vascular disease were found to have lower skin temperatures than a group of healthy subjects.

2. Thermography is a valuable technique in the evaluation of medical therapy efficacy. This has been demonstrated in this study of the use of sulodexide therapy.

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Address for correspondence

Prof. Janusz Domaniecki MD, PhD

Department of Surgery, Wojskowy Instytut Medycyny Lotniczej, 01-755 Warsaw, ul. Krasinskiego 54

Phone/Fax: +48 22 633 70 67

(Manuscript received 3.11.2003, accepted on 10.01.2004)

Report on the Reconstruction Meeting of the „European Association of Thermology“

A. Jung, K. Ammer

European Association of Thermology, A-1170 Vienna, Austria.

The founding members of the “European Association of Thermology” held a special meeting in Vienna at the Sitzungszimmer of the Hanuschkrankenhaus, Heinrich Collinstr.30, 1140 Vienna, on October 30, 2003 at 18.00hrs in order to reconstruct the EAT.

First, the rules of the society were extensively discussed and all participants agreed with the proposed phrasing. The most important change compared to the rules of the old EAT, is the **re-establishment of personal membership**. It is also now possible, to consider persons and thermology societies, living or practising in a country outside Europe, for extraordinary membership in the EAT. An English version of the rules will be found in the near future on the website of the Medical Imaging Research Group, School of Computing, University of Glamorgan at <http://www.medimaging.org>.

In the subsequent election the following officers of the society were unanimously confirmed:

President: Prof. Dr. Anna Jung, Warsaw, Poland

Vice-President: Prof E. Francis J. Ring, Dsc Winsley/Bath, United Kingdom

Secretary and Treasurer: Prof Dr Kurt Ammer Ph.D; Vienna, Austria

In Austrian Law registered societies are required to elect **two finance auditors**.

Dr. Janusz Zuber, Warsaw, Poland, and
Dipl.-Ing. (FH) Peter Plassmann PhD, Cardiff, United Kingdom
were allocated to this function.

The official address of the society is :

European Association of Thermology
p/A Prof.Dr.Kurt Ammer
Hernalser Hauptstraße 209/14
1170 Vienna, Austria

The founding committee had received written applications for membership from 6 national thermology societies in the EAT. The candidates are: Austrian Society of Thermology, German Society of Thermography and Regulation Medicine, UK Thermography Association Medical Section, Hungarian Society of Thermology, Italian Society of Thermology and Polish Society of Thermology. Each society has proposed a delegate for the committee of the EAT. The board of the EAT transferred committee membership to the following **delegates**:

Prim Dr. H. Mayr, Austria,
Prof.Dr.R.Berz, Germany,
K.Howell MSc, United Kingdom,
Prof: Dr. I. Benkö, Hungary,
Dr. G.Dalla-Volta, Italy and
Prof.Dr. B.Wiecek, Poland.

The meeting closed at 20:15

Finally, the Austrian authorities have now accepted the foundation of the “European Association of Thermology” and declared that society to be formally registered on 07.01.2004. The constitution should now be acceptable in all countries within the European Union.

Veranstaltungen (Meetings)

March 3-4, 2004

10th International Programme on Infrared Thermal Imaging, TAMPA, FLORIDA U.S.A.

Location: Tampa, Florida - Rocky Point Center

Hotels: Hyatt Regency, Radisson, Wyndham Westshore, Sheraton Suites, Hampton Inn Rocky Point & Westshore, Holiday Inn Express Rocky Point

Registration Fee - Space is Limited First Time Attendees: \$250 per person pre-registered by December 31, 2003

Confirm that you are attending by sending an email to: thermology.com

Payable to: Ashwin Systems International Inc. P.O. Box 1014, Dunedin, FL 34697 U.S.A. - Tel. 813/228-6650

March 15-18, 2004

The Multiple Applications of Infrared Thermography, a Tool for Measurement, Characterization and Monitoring, a 3.5 - Day Short Course to be held at the Continuing Education Dept of Ecole Normale Supérieure of Cachan, Paris, France

Information: Ecole Normale Supérieure de Cachan
Service Formation Continue et Développement
61 avenue du Président Wilson
94235 Cachan Cedex, France

Tel. :33 (0)147407500 ; Fax: 33 (0)1 4740 75 10
e-mail: fcd@ens-cachan.fr

April 3-4, 2004

7 Congress of the Polish Association of Thermology in Zakopane, Poland

Venue: „HYRNY”; ul. Pilsudskiego 20, 34-500 Zakopane
Deadline for abstracts: 15.12.2003.

Organising office:

ATAS Sp. z o.o. Pl. Konstytucji 4/17 Warszawa

Information: ATAS: Malgorzata Slawińska
tel. 022 - 875 04 40, 022 - 825 74 77, fax 022 - 825 74 77
e-mail: atas@atas.com.pl, atas@atas.pl

or Prof. Dr. Anna Jung
Klinika Pediatrii i Nefrologii Dzieciêcej
Wojskowego Instytutu Medycznego
00-909 Warszawa, ul. Szaserów 128
tel. (0-22) 6817-236, tel./fax (0-22) 6816-763
e-mail: a.jung@wim.mil.pl

April 15-18, 2004

31st Annual Meeting of the American Academy of Thermology and the Conference on International Standards for Thermology in Human and Animal Research and Medicine in Auburn, Alabama, U.S.A.

Chairman, Scientific Program: Dr. David D. Pascoe

Chairman, Standards Symposium: Dr. Ram C. Purohit

Program Organizer: Dr. Richard Herrick

Information:

David D. Pascoe2050

Memorial Coliseum Auburn University, AL 36849. U.S.A

phone: (334) 844-1479

email: Pascodd@auburn.edu

June 5-6, 2004

The **6th International Congress of Thermology** combined with 13th Annual Meeting of the Korean Academy of Medical Thermology

Venue: Konkuk university, New Millennium Hall
#1 Hwayang-dong Gwangjin-gu, Seoul 143-701, Korea

Tel +82-2-455-1896-7, Fax +82-2-455-4084

<http://www.konkuk.ac.kr>

Information;

Secretary General Yong-Eun Cho, M.D., Ph.D.

Department of Neurosurgery, Yongdong Severance Hospital,
Yonsei University College of Medicine, Seoul, Korea

Tel : +82-2-3497-3390, Fax +82-2-3461-9229

E-mail: ydnscho@yumc.yonsei.ac.kr

25.-27 Juni .2004

Jubiläumskongress der Deutschen Gesellschaft für Thermographie und Regulationsmedizin in München Deutschland

Information: Deutsche Gesellschaft für Thermographie und Regulationsmedizin e.V.,

An der Steig 6, D-88483 Burgrieden-Rot,
Tel. +49 7392 704945 oder +49 160 96712989

Email: reinhold.berz@inframedic.de

WebSite: <http://www.thermommed.org>

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on InfraRed Thermal Imaging in Medicine at the
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Topics: Thermal Physiology and skin temperature,
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Prof K Ammer MD, PhD (Vienna)

Prof FJ Ring Dsc FIPEM (Glamorgan)

Dipl Ing (FH) P Plassmann PhD (Glamorgan)

Dr R Thomas (Swansea)

Accommodation available.

Application forms from Prof Ring, Medical Imaging
Research Group; School of Computing, University of
Glamorgan, Pontypridd CF37 1DL, UK, efring@glam.ac.uk

**Einladung zur
Generalversammlung der
Österreichischen Gesellschaft für Thermologie**

am 25. Februar 2004 um 19.30 Uhr .
in Ordinationsräume von Prim. Dr. H. Mayr,
Wien 14., Felbigergasse 110.

Tagesordnung

Bericht des Präsidenten

Bericht des Sekretärs

Bericht des Kassiers

Festlegung des Mitgliedbeitrages

Bericht der Rechnungsprüfer und Entlastung des
Vorstandes

Neuwahl des Vorstandes

Allfälliges

Anträge an die Generalversammlung sind mindestens
48 Stunden vor dem Termin der Generalversammlung
schriftlich beim Präsidium einzureichen.

July 5-8, 2004

**7th International Conference on Quantitative Infrared
Thermography - QIRT 2004**

von Karman Institute for Fluid Dynamics,
Rhode-St-Genèse, Belgium

Information: QIRT2004 secretary

von Karman Institute for Fluid Dynamics
Chaussée de Waterloo, 72
B-1640 Rhode-St-Genèse, Belgium

Phone : +32 359 96 11 Fax : +32 359 96 00

Additional information available on the
QIRT'2004 web site: www.vki.ac.be/qirt2004

Thermology international

Dr. Kurt Ammer
Österreichische Gesellschaft für Thermologie

Hernalser Hauptstr.209/14
A-1170 Wien
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