Annual Meeting of the American Academy of Thermology, Greenville, South Carolina, October 27, 2012

Programme

Jeffrey Lefko Greenville, SC, Executive Director, American Academy of Thermology
Welcome remarks

Session 1: Basic Science, Clinical Conditions, Skin Temperature Regulation, AAT Guidelines & Indications

Dr. Robert Schwartz, Greenville, SC, President of American Academy of Thermology
Introduction to Thermal Imaging,
The AAT Neuro-Musculoskeletal Guidelines,
Vasomotor Mapping and Sympathetic Generators

Dr. Philip Getson, Marlton, NJ, Chairman of AAT Committee on Guidelines for Breast Thermography
The AAT Breast Guidelines

Dr. Philip Getson:
Breast Pain Syndromes & Predictive Value of Thermography in CRPS

Session 2: Medical Thermal Imaging: Its Role in Objective Measurement and Treatment Planning

Dr. William Hobbins, Madison, WI:
Somatovisceral Pain & Thermal Imaging

Dr. Kamayni Argawal Hamburg, Germany
Thermographic Monitoring of Sympatheticomy and SCSG Blocks

Dr. Timothy Conwell, Denver, CO
Distinct Infrared Signatures in Patients with Neuropathic Abnormalities of the Limbs

Session 3: Vasomotor Monitoring, Neurovascular Considerations, Pitfalls and Look Alikes

Dr. Robert Schwartz
RSD Look Alikes

Dr. William Hobbins
Breast Imaging Significance and Suggestions

Dr. Kamayni Argawal
Thermal Imaging in Acupuncture

Dr. Debra Sime, Raleigh, NC:
Thermal Imaging Applications in Animal Care

Dr. Kenneth Marcella, Canton, GA
Infrared Imaging in Equine Sports

Session 4: Infrared Thermal Imaging Case Presentations and Paper Presentations

Dr. Andrzej Zielke, North Huntingdon, PA
Infrared Monitoring & Laser Therapy

Dr. Bryan O'Young, New York City, NY
Acupotomy: Soft Tissue Release with Thermal Monitoring

Martin Bales, Solana Beach, CA
Integrative Pain Therapies Monitored by Thermal Imaging

Dr. Tashof Bernton, & Dr. Geroge Schakaraschiwili, Denver, CO
Setting up a Thermal Imaging Lab

James Melton, Cary, NC
Medical Publishing: The Duke Clinical Research Institute Experience

Abstracts

INTRODUCTION TO THERMAL IMAGING THE AAT NEURO-MUSCULOSKELETAL GUIDELINES VASOMOTOR MAPPING AND SYMPATHETIC GENERATORS

Robert G. Schwartz
Greenville, South Carolina

HEADLINES OF SLIDES

Peripheral Nerve Anatomy - Sympathetic Nerve Anatomy - NMSK Sympathetic Generators - RSD Differential Diagnosis - CRPS/RSD: History -Usually preceded by an identifiable injury or event (major or minor) - Burning, knawing, cold sensitive, allodynia - May directly involve any tissue (CRPS I) or nerve (CRPS II)- Physical Exam - oSympathetic pain: overly sensitive tissue - RSD With Dystonic Features - RSD & Spread -Somatovisceral Pain - Typical Injury Model - Expanded Injury Model - Diagnosis of RSD/CRPS - Efficacy Of Stellate Block - Electric Stellate Block - Flouroscopic Guidance & Sympathetic Block - Pain Score Tests - Three Phase Bone Scan - Bone Scan & Clinical Practice - SSR Studies Measure Skin Temperature & Maps SGI - Skin temperature is vasomotor & sudomotor dependant - SGI mapping provides insight into structures as generators - SSR is expected to be symmetric - Abnormal findings present as a side to side GSI or GSR asymmetry pattern (> 1 degree centigrade) - Controlled Conditions - SSR Asymmetry Patterns - LLE RSD - LLE RSD L5 Distribution - LUE RSD (Radial-Humeral Lig.) - Describing Asymmetry Patterns - SSR Impression - Variants Exist: ABC Syndrome - CCC Syndrome - Direct Clinical Impact: Drug Selection - RSD Generators: Trauma - RSD Generators: Bone - RSD Generators: Dura - RSD Generators: Disk - RSD Generators: SVN - RSD Generators: Tendinosis - RSD Generators: Ligament - RSD Generators: Vein - RSD Generators: Skin - RSD Generators: Treatment Should Address The Source - Block Above & Treat The Source - Block Above May Treat The Source - Block Above & Treat Below - AAT Guidelines: SSR Indications - AAT Guidelines: SSR Indications - Thermal Imaging is Clinically Important - Summary RSD Diagnosis

THE AAT BREAST GUIDELINES

Philip Getson
Marlton, New Jersey

HEADLINES OF CHAPTERS

General Statement: - Statement of Need - Breast Thermography (Purpose, Indications, Contraindications and Limitations) - Guideline 1: Patient Communication and Pre Examination Preparation - Guideline 2: Patient Assessment - Guideline 3: Examination Guidelines - Guideline 4: Review of the Infrared Thermography Examination - Guideline 5: Preparation and Storage of Exam Findings - Guideline 6: Exam Time Considerations - Guideline 7: Continuing Professional Education - Guideline 8: Informed Consent - Guideline 9: Reporting - References

SOMATOVISCERAL PAIN AND THERMAL IMAGING

Bill Hobbins
Madison, Wisconsin

In the 16th century it was believed that the skin of the human body was able to have effect on the viscera, and the viscera could have effect on the skin.

Since the 18th century, man has attempted to understand the relationship of skin to the viscera:

In 1893, H. Head in 131 pages, showed the cutaneous relationship between skin and viscera, when there is referred pain. Each specific territory would show the following changes with the visceral pain: with specific diagrams of territories of all viscera of the body, which showed the following changes when there was visceral pain: 1. Paresthesia 2. Hyperthermia 3. Tension (tenderness).

All of H. Head's diagrams and thermograms have been verified today by authors: Kellgren, Richter, Umeatsu, Travell and Hobbins. And examples of these observations will be demonstrated.

This age old discussion has in the past century been solved for a more satisfactory answer. In a capsule, it is that all referred visceral somatic pain is a result of the smooth muscle attitude expressed as blood flow, altered by the extra spinal sympathetic nervous system control. This pain system is expressed through the same pathways as our major temperature control, by the autonomic sympathetic ganglion, which is an extra spinal ganglion mediated system.

The paper proposes that any and all pains of this origin can be objectified by thermography, which will verify the suspected diagnosis. This will increase the accuracy of diagnosis and therapy.

DISTINCT INFRARED SIGNATURES IN PATIENTS WITH NEUROPATHIC ABNORMALITIES OF THE LIMBS

T. D. Conwell
Denver; Colorado

Infrared (IR) imaging sensitively detects and precisely delineates variations in skin temperature useful in the evaluation out in a painful conditions involving peripheral nerves of the limbs. IR imaging is useful in evaluating patients expressing positive sensory symptoms that originate from dysfunction of small caliber, mostly unmyelinated, nociceptor and sympathetic vasomotor nerve fibers. Conversely, conventional nerve conduction studies exclusively test nerve impulse conduction in large-caliber, myelinated sensory and motor fibers.

Distinct IR signatures result from neuropathic abnormalities, focal inflammation and vascular disease. There are four (4) distinct IR signatures which occur as a result of neuropathic abnormalities in an affected painful limb. There are two "cold" and two "hot" IR signatures. Provocative cold water autonomic reflex testing is helpful in differentiating the pathophysiological mechanisms of the two "cold" and the two "hot" IR signatures. Provocative cold water autonomic reflex testing is performed by immersion of an asymptomatic unaffected limb in a cold water bath, which produces systemic distal cooling (vasoconstriction) in the limbs in a normal asymptomatic population (i.e., patients with an intact and functioning SNS). In patients with impaired SNS function (inhibition/failure) in the affected limb there is observed paroxysmal warming.

Distinct "cold" IR signature I is due to a normal somato- autonomic reflex secondary to a peripheral pain generator(s) or excitation of a nociceptor commonly referred to somatosympathetic reflex vasoconstriction. Excitation or irritation of sensory receptors elicits vasoconstriction (cooling) of the skin predominately visualized in the territory of the affected nerve or in a

global nondermatomal pattern from excitation of a somatic nociceptor. This patient population demonstrates hypothermic IR signatures in the affected limb either in the skin territory of the involved nerve or in a global distribution from somatic nociceptor impulse. These patients respondednormally to provocative cold water autonomic reflex testing, indicative an intact and functioning SNS.

Distinct "cold" IR signature II isas a result of exaggerated catecholamine responsiveness as a result of receptor up-regulation related to reduced SNS outflow. Chronic inhibition or interruption of the postganglionic sympathetic neurons (impaired SNS function) innervating the microcirculation to the skin initially produces vasodilatation as a result of lower norepinephrine levels in the affected limb. This phenomenon eventually leads to vasospasm in arteriolar smooth muscle secondary to sympathetic denervation hypersensitivity to circulating catecholamines. This patient population demonstrates a global nondermatomal hypothermic IR signature in the involved limb with observed absent or minimal cooling to provocative cold water autonomic reflex testing.

Distinct "hot" IR signature I is aresult of altered SNS function due to inhibition/failure of the vasoconstrictor impulses following nerve trauma or sympathoparalytic vasodilatation post sympathetic blockade, sympathectomy, somatic nerve blockade or neurectomy. The vasodilatation is a result of removal of the sympathetic mediated vasoconstrictor tone. The hyperthermic IR signatureis specific to the involved nerve following somatic nerve block or neurectomy. The hyperthermic IR signature is in a global nondermatomal distribution following sympathetic blockade or sympathectomy. There is paroxysmal warming of the involved limb with provocative cold water autonomic reflex testing, indicative of inhibition/failure of the SNS vaso-co nstrictor reflex.

Distinct "hot" IR signatureII is due to neurogenic inflammation producing antidromic and humoral vasodilatation mediated by release of proinflammatory cytokines (e.g., TNF-alpha, interleukin-1β,-2,and-6) and proinflammatory neuropeptides (e.g., SP, CGRP, bradykinin). This hyperthermic IR signature is independent of sympathetic activity. This hyperthermic IR signature is visualized in the specific skin territory of the involved nerve (e.g., small caliber fiber neuropathy) or in a global non dermatomal distribution in patients with plexus (e.g., brachial plexopathy) or peripheral neuropathy (e.g., diabetes). Provocative cold water autonomic reflex testing results in a somatosympathetic reflex vasoconstriction that overrides the vasodilatation from proinflammatory cytokines and neuropeptides. This patient population demonstrates normal vasoconstriction with provocative cold water autonomic reflex testing, indicative of an intact and functioning SNS.

RSD LOOK ALIKES

Robert G. Schwartz
Greenville, SouthCarolina

HEADLINES OF SLIDE

Barre-Lieou - TOS - RSD Look Alike: Raynaud's Syndrome - RSD Look Alike: Vibration (White Finger) Syndrome - RSD Look Alike: Buerger's Disease - RSD Look Alike: Post Radiation Fibrosis -RSD Look Alike: Gout - RSD Look Alike: RTC Syndrome - RSD Look Alike: Livido Reticularis - RSD Look Alike: Coagulopathy - RSD Look Alike: Ligamentous Strain - RSD Look Alike: Erythromelalgia - RSD Look Alike: Cellulitis - RSD Look Alike: Pernio (Chilblains) - RSD Look Alike: Blue Toe Syndrome - RSD Look Alike: Ischemic Foot - RSD Look Alike: Venous Thrombosis - RSD & Co-morbid Disease - Co Morbid Disease: Guillan Barre - Co Morbid Disease: Breast CA - Conclusion: RSD/CRPS, Comorbid Diseaseand Look Alikes are Multifactorial

BREAST IMAGING SIGNIFICANCE AND SUGGESTIONS

Bill Hobbins
Madison, Wisconsin

The musings of a general surgeon of 63 yearspractice of breast health and disease and with special interest of integrating the thermography for the last 39 years.

This will deal with the anatomy, physiology and pathology of breast measurement of blood flow by means of qualitative and quantitative thermography.

Study of normal and abnormal breast expressionof blood flow by thermography. This is possible as the breast is a skin organ and the skin is a perfect black body and the observations are precise.

The thermography (blood flow) of the breast is modified by the the following vascular conditions of the breast: youth, fertility, pregnancy, nursing, inflammations, injury, influence of chemicals (drugs and hormones), neoplasia, and effects of therapy with anti-angiogenesis. Thus predicting recurrences and prognosis.

These must be studied to beable to use this modality in each detection of neoplasia. This willbeillustrated through the use of graphs, tables, and charts.

The major discussion of how to improve the thermographic standard and to use this information in relationship to the prevention and protection of the breast by awareness of influence of drugs, diets, and supplements on the health of the breast.

INFRARED THERMOGRAPHY APPLICATIONS IN ANIMAL CARE

Debra M. Sime, Rachel Cezar, Tracy A. Turner, Vaughan Langman
USDA-APHIS-Animal Care, Raleigh, North Carolina

The Animal Care program, which is part of the United States Department of Agriculture's Animal and PlantHealth Inspection Service, provides leadership for determining standards of humane care and treatment of animals covered under the Animal Welfare and Horse Protection Acts. The Animal Care program has added infrared thermography technology to its effort to achieve compliance through inspection, education, cooperative efforts, and enforcement. Underthe Animal Welfare Act infrared technology is used under the direction of the Biophysics Animal Care Specialist at the Center for Animal Welfare. Absolute temperatures from an infrared thermal camera are applied to biophysical ecology analysis of thermal neutral zones and insulation factors of animals. Using infrared thermography the Animal Care program has been able to identify insulation factors and thermal neutral zones in a wide range of animals. The Animal Care Horse Protection program isusing infrared thermography as a technology to screen horses forsoring prior to the inspection process. Under the Horse Protection Act horses that have been subjected to a practice called soring are prohibited from participating in shows, sales, exhibitions, or auctions. Infrared thermography identifies abnormalities by measuring thesurface temperature of a horse's legs anddepicting color patterns that are excessively warm or cool, both of which may reveal an abnormality indicative of soring. Horses thatexhibit a pattern of "Not Normal" are subjected to greater scrutiny under the inspection process to ensure sore horses are prohibited from participating in shows, sales, exhibitions, or auctions. The use of infrared thermography technology by the Animal Care program contributes to the latest information in animal welfare science and technology.

THERMOGRAPHIC MONITORING OF LASER THERAPY OF RSD PATIENT - A CASE STUDY

Andrzej Zielke
North Huntingdon, Pennsylvania

Laser therapy is known to restore the ATP levels in compromised cells, which enable the cells to regain homeostasis, accelerate healing and regenerate. Laser therapy can be used as direct irradiation of the affected tissues or as blood irradiation to take advantage of the systemic effect.

The treatment choice depends on the individual clinical problem. Inflammatory conditions such as arthritis, respond better to a direct irradiation of the affected joints. Reflex Sympathetic Dystrophy (RSD) on the other hand, is better treated with blood irradiation.

The patient involved in this case study was a 48 year old white female with well documented RSD of the right upper extremity following tendon injury of the first digit in 1999 which resulted in 11 reconstructive surgeries. Subsequently, the patient developed severe case of RSD that was poorly controlled with conventional approaches such as stellate ganglion blocks and pharmacologic treatments. For the last two years the patient has received laser therapy via percutaneous blood irradiation every two to four weeks which produced significant improvement of pain and other symptoms of RSD. For objective evaluation of the effectiveness of laser therapy, the patient was scheduled for treatment session under thermographic monitoring. The day of the study was chosen when the patient was severely symptomatic.

Equipment: Laser: 2 diodes, GaAs pulsing diode, wavelength 910nm, peak power 45W, pulse width 200ns and GaAs 635nm 12mW continues wave. Thermographic camera: FLIR A40.

Type of treatment: percutaneous blood irradiation via subclavian vein bilaterally. Subclavian veins are located immediately under the clavicles, and can be effectively irradiated percutaneously between one half and one third of the proximal part of the clavicles by pointing the laser beam up and medially just under the lower edge of the clavicles. Percutaneous subclavian vein irradiation may be performed either on the ipsilateral or contralateral side of the body in relation to the affected extremity with the same results. Subclavian veins offers an excellent approach for percutaneous blood irradiation because they carry 16% of cardiac output each and are easily accessible.

The study was performed in a climate control treatment room of the ambient temperature of 20 degrees Celsius. Patient was acclimated for 15 min before the study. Thermographic images were taken before, during and after irradiation. Percutaneous blood irradiation was first performed on the ipsilateral vein for 10 min followed by 5 min pause and then by irradiation of the contralateral subclavian vein for 8 min.

Results: the thermographic images showed a gradual and steady improvement of the skin temperature of the affected extremity which coincided with subjective reduction of symptoms. The patient reported a warming sensation of the extremity, elimination of numbness, and significant alleviation of pain. Patient follow up the next day revealed that the peak effect of Iaser therapy occurred in less than one hour alter treatment and Iasted about twelve hours. After that time, the effect started to wear oft. However, the pain Ievei was still significantly lower the next day.

ACUPOTOMY: SOFT TISSUE RELEASE WITH THERMAL MONITORING

Bryan O'Young
New York City, New York

Acupotomy is a novel approach to soft tissue release using an acupuncture needle with a blade at one end instead of the traditional needle tip to penetrate soft tissues in managing soft tissue pathologies. It is a synergistic combination of traditional Chinese acupuncture and western surgery to treat many difficult soft tissue cases including lumbar disc herniation with nerve root compression and shoulder adhesive capsulitis, with minimal soft tissue invasion in a matter of minutes in an outpatient setting. Acupotomy will be introduced in this presentation and this will be followed by a brief case study using thermal imaging to monitor the effects of acupotomy.

THERMAL EFFECT OF PULSED ELECTRO-MAGNETIC FIELD AND CLASS IV LASER THERAPIES ON HUMAN GASTROCNEMIUS

Martin Bales
Solana Beach, California

Two alternative pain therapies, Pulsed Electro-Magnetic Field (PEMF), and class IV Laser (Laser), have been shown to provide a myriad of benefits including increased local blood profusion, increased oxygenation of the blood, decreased inflammation, and an overall reduction in musculoskeletal healing times. There is much discussion as to the mechanisms of action of these modalities, and, as such, research on their thermal effect may provide additional information necessary to understand the science behind their efficacy. As a small study, 3 participants with healthy, asymptomatic gastrocnemius muscles were thermally imaged before and after each of PEMF and Laser therapies. The intensity of the PEMF was set to the highest tolerable by the volunteer while the intensity of the Laser was set to 8 watts (8000 mW) continuous wave, 800 and 910 nanometer combined wavelength. The PEMF utilized the "butterfly" treatment module wrapped around the gastrocnemius while the Laser was administered by hand in a circular motion over the gastrocnemius. Both therapies were administered for 6 minutes. All 3 participants showed no significant change in temperature (delta T) from the baseline image to the image captured directly after the administration of PEMF therapy. Conversely, all 3 participants showed a significant delta T from the baseline image to the image captured directly after the administration of Laser therapy. This data suggests that PEMF therapy has little to no effect on local area cutaneous blood profusion while Laser therapy has a significant, profound effect. As the sympathetic nervous system (SNS) is the governor of local area blood profusion, this data further suggests that the mechanism of action (MOA) of Laser therapy has direct effects on the SNS while the MOA of PEMF therapy has no direct effect on the SNS.

SETTING UP A THERMOLOGY LABORATORY:

George Schakaraschwili, J. Tashof Bernton
Colorado Rehabilitation and Occupational Medicine, Denver, Colorado

Our experience in setting up a laboratory for the use of thermography to aid in the diagnosis of CRPS is discussed. Guidelines for use of thermography, camera specifications, laboratory parameters, patient preparation, specific protocols and image capture are discussed. Imaging processing, data analysis and report generation are detailed. Pitfalls and alternate diagnoses are considered and two clinical cases are presented. At the end of the presentation, participants will be aware of the issues involved in setting up a laboratory for the clinical application of infrared imaging.