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Contents

Original article

Meetings

Use of Infrared Thermography in the clinical assessment of chronic testicular pain with possible radicular origin: a case report

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SUMMARY

Chronic scrotal pain is a condition characterized by pain or discomfort in the scrotal contents that lasts for more than 3 months and significantly interferes with the patient's daily routine. It can have various causes, including several diseases, syndromes, and nerve compression, affecting over 100,000 men annually in the US, and requires a multidisciplinary approach for proper management.

This report presents a case of chronic testicular pain in a sedentary 65-year-old man who reported persistent pain in the left testicle, proximal medial thigh, and inguinal area for 4 years, which worsened throughout the day and affected his quality of life. Infrared thermography (IRT), a non-invasive technology that measures infrared radiation emitted from ob- jects and has been used in various medical specialties, was employed in the clinical workup. This case report describes the potential use of IRT in the investigation of chronic testicular pain with an unclear etiology, where a possible radicular ori- gin was considered, and discusses the potential use of this technology as a non-invasive propaedeutic tool that can pro- vide clues to autonomic dysfunctions possibly associated with chronic testicular pain.

Key-words: Chronic testicular pain, infrared thermography, radiculopathy, urology, case report

EINSATZ DER INFRAROT-THERMOGRAFIE IN DER KLINISCHEN UNTERSUCHUNG CHRONISCHER HODENSCHMERZEN MIT MÖGLICHER RADIKULÄRER URSACHE: EIN FALLBERICHT

Chronische Hodenschmerzen ist eine Erkrankung, die durch Schmerzen oder Beschwerden der Hodeninhalte ge- kennzeichnet ist, länger als 3 Monate anhält und den Alltag des Patienten erheblich beeinträchtigt. Die Beschwerden können verschiedene Ursachen haben, einschließlich mehrerer Krankheiten, Syndrome und Nervenkompression, die jährlich über 100.000 Männer in den USA betreffen und eine multidisziplinäre Herangehensweise erfordern, um angemessen behandelt zu werden. Dieser Bericht beschreibt einen Fall von chronischen Hodenschmerzen bei einem 65-jährigen vorwiegend sitzenden Mann, der über persistierende Schmerzen im linken Hoden, proximalen medialen Oberschenkel und Leistenbereich seit 4 Jahren berichtete, die sich im Laufe des Tages verschlechterten und seine Lebensqualität beeinträchtigten. Die Infrarot-Thermografie (IRT), eine nicht-invasive Technologie, die Infrarotstrahlung von Objekten misst und in verschiedenen medizinischen Fachgebieten eingesetzt wurde, wurde in der klinischen Untersuchung eingesetzt. Dieser Fallbericht beschreibt die potenzielle Verwendung von IRT bei der Untersuchung von chronischen Hodenschmerzen mit unklarer Ätiologie, bei der eine mögliche radikuläre Ursache in Betracht gezogen wurde, und diskutiert die potenzielle Verwendung dieser Technologie als nicht-invasives propädeutisches Instrument, das Hinweise auf autonome Dysfunktionen liefern kann, die möglicherweise mit chronischen Hodenschmerzen assoziiert sind.

Schlüsselwörter: Chronischer Hodenschmerz, Infrarot-Thermografie, Radikulopathie, Urologie, Fallbericht.

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Introduction

Chronic testicular pain, chronic scrotal pain, chronic orchialgia, testalgia, and testicular pain syndrome are terms that refer to the so-called Chronic Scrotal Pain [1]. According to the International Association for the Study of Pain (IASP), pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage" [2], and when persistent for more than 3 months, is effectively qualified as chronic pain. Therefore, "Chronic Scrotal Pain" is a condition of pain or discomfort in the scrotal contents (including the spermatic cord, epididymis, and/or testicle) that can be continuous or intermittent, lasting for more than 3 months and significantly interfering with the patient's daily routine [1].

Its causes are diverse, most commonly caused by hydrocele, spermatocele, varicocele, testicular and paratesticular tumors, and infectious or inflammatory diseases of the epididymis leading to chronic epididymitis [3]. In addition, post-vasectomy pain syndrome, post-herniorrhaphy nerve compression, pelvic muscle hypercontraction, calculous ureteral obstruction, hip diseases, retroperitoneal tumors, and intervertebral disc diseases [3] contribute to the etiological diversity of this condition. In the United States, chronic pain in the scrotal region represents about 5% of urological consultations and about 1% of medical consultations in primary health care services, affecting over 100,000 men annually, at a cost exceeding 55 million dollars

[1,4]. According to the European Association of Urology, management of scrotal pain syndrome should preferably be multidisciplinary [5] and can often be a source of great frustration not only for the patient but for anyone involved in its diagnosis and treatment [6,7].

Infrared thermography (IRT) is based on a set of sensors capable of measuring the infrared radiation emitted from any object with a temperature above absolute zero [8, 9], which transforms the captured data into an image based on a color scale. This technology is non-invasive, does not emit ionizing radiation, and provides quantitative results quickly and painlessly. It was introduced in medicine in 1956 by Canadian surgeon Lawson as a promising modality for breast cancer diagnosis [10] and has been applied in various medical specialties [11]. Some areas suggest promising results, such as the detection of spinal radiculopathies using IRT. Studies have reported changes in skin temperature caused by cervical hernias [12, 13], low back pain [14, 15], and low back pain with sciatica [16, 17], although this relationship is not consensual and not obvious when other studies are observed [18, 19, 20, 21].

Testicular pain syndrome is a condition with universal distribution. Its multiple origins can make the etiological diagnosis and even management a frustrating challenge for the patient and the entire therapeutic team, especially when available imaging exams do not sufficiently clarify the condition. This case report describes how IRT was employed in the clinical investigation of a case of chronic testicular pain without an etiological diagnosis obtained with the use of other imaging techniques, in which a possible radicular origin was assumed.

Clinical and Epidemiological Findings

This report adheres to the CARE guideline [60] for describing a case of chronic testicular pain in a 65-year-old Afro-Brazilian man who is retired from a technical-administrative service, with a height of 1.73m and a sedentary lifestyle. The patient has a BMI within the expected normal range for his age, sex, and body type, and a medical history of systemic arterial hypertension, hypothyroidism, dyslipidemia, gastroesophageal reflux disease, and mild gastritis, which he reports being adequately monitored, treated, and controlled. He denies any previous history of sexually transmitted diseases, multiple sexual partners, or vasectomy. The patient presented to a pain medicine service with pain in the left testicle, proximal medial thigh, and inguinal area, which had been persistent for approximately 5 years. The pain had an intermittent pattern associated with burning and tightness, absent in the morning and progressively worsening throughout the day, culminating at night and affecting his sleep quality.

Medical Timeline

2008

The patient reported that in 2008, he was diagnosed with prostate cancer and underwent a radical prostatectomy. He remained under medical care for 5 years and was discharged by his urologist based on the fact that his prostate-specific antigen (PSA) level was trending towards zero, and the patient remained asymptomatic.

2018

Approximately 10 years later, the patient started experiencing left testicular pain that radiated to the inguinal region, medial thigh, and left flank, which progressively worsened throughout the day, daily. The patient continued to experience pain of the same characteristic for around 7 months until he sought new urological care, where an ultrasound revealed a diagnosis of a left inguinal hernia.

In the end of 2018, the patient underwent left inguinal herniorrhaphy by an experienced general surgeon, with mesh implantation. After this procedure, which went without complications at the time, the patient reported relative relief of scrotal pain, but not complete relief. However, about 30 days after the procedure, he reported a recurrence of pain, with the same pattern as before surgery, but now accompanied by the clear sensation of left testicular swelling at the end of the day. The patient reported that this was not a disabling pain condition, but the persistence of symptoms "took away his will to live".

The patient remained with pain refractory to simple analgesics, non-steroidal anti-inflammatory drugs, and weak opioids such as tramadol and codeine, hoping that the pain would improve, and so he remained for almost 2 years.

2021

In 2021, he sought evaluation from a chiropractor, whose therapy did not result in relief, and then an experienced orthopedist initiated a detailed diagnostic assessment. In the absence of orthopedic abnormalities that could justify his pain, the patient sought the help of a new urologist, who ordered new imaging exams

None of these specialists were able to present a justifiable etiology for the painful condition.

2022

In 2022, when seeking evaluation from a pain management certified physician, the patient reported that his painful condition had not changed, maintaining the sensation of having a swollen left testicle, even though the ultrasound examination showed a slight reduction in testicular volume on the left side. In the absence of relevant results from the anatomical/radiological investigation, the pain doctor recommended performing a full-body infrared thermography exam.

Diagnostic Assessment

Orthopaedic Assessment (2021)

- Pelvic radiography showed no structural or morphological abnormalities;
- Total spine radiography for scoliosis and lumbosacral spine revealed an "S"-shaped scoliosis with convexity to the right in the thoracic spine and convexity to the left in the lumbar spine, with left iliac crest elevation of 1.3 cm

compared to the right. Marginal osteophytes were observed, but no other structural or morphological abnormalities.

- Dorsal spine magnetic resonance imaging showed slight signal increase in the vertebral body of T3, discrete interapophyseal and costo-vertebral degenerative changes; no relevant radicular compression or medullary or radicular abnormalities were evidenced;
- Lumbar spine magnetic resonance imaging showed slight disc protrusion with slight narrowing of the neural foramen at L3-L4 without radicular conflict and asymmetric disc protrusion between L4-L5, slightly larger on the left, but without radicular conflict; however, the presence of edema in the interspinous ligament with a probable mechanical origin was evidenced.

Urological Assessment (2021)

- Scrotal ultrasonography revealed a small hydrocele, mild ectasia of the pampiniform plexus vessels without reflux on the Valsalva maneuver, and mild volumetric reduction of the left testicle;
- Abdomen and pelvis computed tomography without contrast revealed small hepatic and renal cysts (bilateral) and renal microlithiasis on the left side without ureteral dilation on this side;
- Lumbosacral spine computed tomography showed preserved osteoligamentary morphology with minimal marginal osteophytes. It also showed slight protrusions of the posterior margin of the intervertebral discs at L3-L4 and L4-L5, straightening the anterior contour of the dural sac, but did not show radicular compression, spondylolysis, or spondylolisthesis.

Pain Medicine Assessment (2022)

Full Body Thermography

The exam was performed in a controlled environment using a FLIR T430sc infrared sensor (FLIR® Inc. Sweden), with a thermal resolution of 320x240 pixels, focal length of 0mm, thermal sensitivity of 30mK, and exposure time of 1/59 s. The patient was completely undressed, covered only by a very thin and breathable non-woven gown that was insufficient for heat retention for a 15-minute period of thermal stabilization and acclimatization, which is an accepted standardization in international literature [22, 23, 24, 25], in an environment at 23.0±1.0 ºC [25], a well-documented measure of thermal comfort in Brazil [26, 27], and recommended by the Brazilian Association of Thermology [23] because it is not cold enough to cause shivering or muscle spasms, and adjusted to the population of this country. Minimal air convection (0.2 m/s) and relative air humidity below 60% [23] were also ensured by a thermo- hygrometer. This study consisted of 39 thermal images covering 90 neurovascular territories bilaterally, with additional thermograms taken in positions for exposure of the perineum for evaluation of the testicles and the proximal medial region of the thighs. Subsequently, the images were analyzed using ResearchIR+ software (FLIR®, FLIR Research IR Max 4.4. 2017, FLIR® Inc).

Several studies have addressed the role of IRT in researching the Autonomic Nervous System (ANS) [28, 29, 30], indirectly identifying sympathetic activation through the modification of heat exchanges with the environment by regulating skin perfusion [28]. This feature, in particular, makes IRT a potential resource for the study of pain. It is important to note that while pain as a stressor activates the Sympathetic Nervous System (SNS), the activation of the Autonomic Nervous System (ANS) can suppress or, in pathological states, increase pain. Such interaction can occur both peripherally and in the Central Nervous System (CNS) [31, 32].

The most relevant thermograms for this report are presented below:

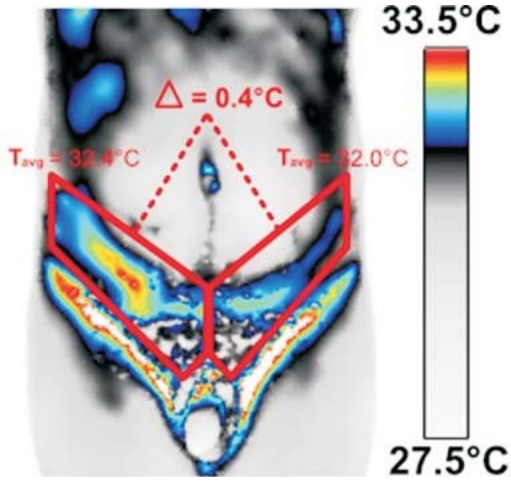

Figure 1:
apparent thermographic asymmetry between the inguinal regions, less radiant on the left - regions corresponding to the innervation of the iliohypogastric and genitofemoral nerves topography (and also to the dermatome relative to L1) [33] - with ΔTavg of the ROIs (Regions of Interest) of 0.4°C.

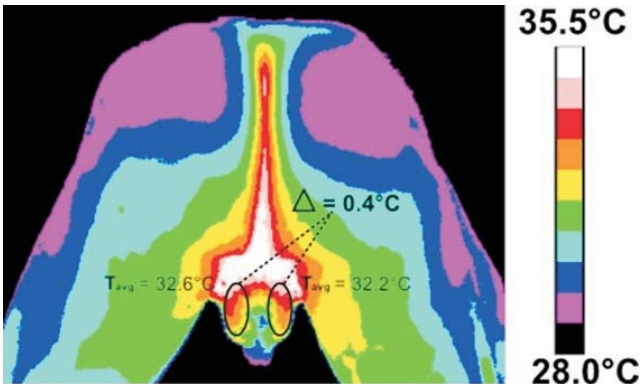

Figure 2:
apparent thermographic asymmetry between the medial-proximal regions of the thighs, suggesting less radiant on the left - regions corresponding to the dermatomes relative to L2 and L3. Thermal analysis of the scrotal sac in this selection suggests apparent thermographic asymmetry between the topographies of the testicles, more radiant on the left with ΔTavg between the selections of 0.4°C.

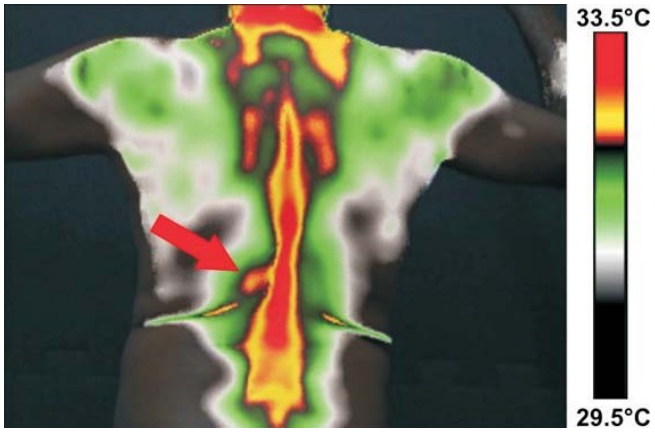

Figure 3:
apparent thermographic asymmetry in the thoracolumbar topography, suggesting a coalescent hot-spot image to the axial and paraspinal topography with no contralateral correspondence.

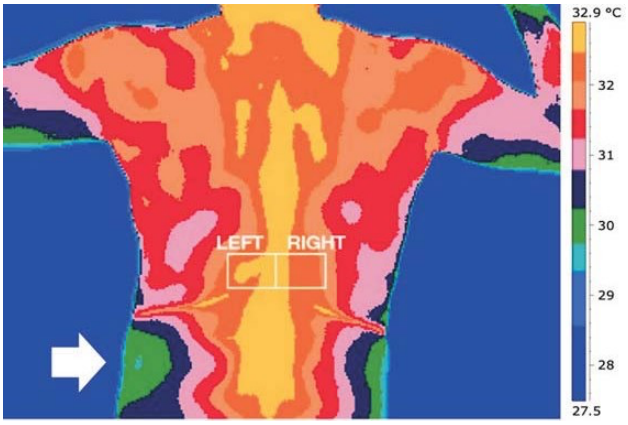

Figure 5:
definition of ROIs in LEFT and RIGHT in apparent thermographic asymmetry suspected during the clinical-thermological examination and region of apparent lower infrared radiation in the left hip topography (arrow).

Additionally, the patient was asked to fill out a pain map, as part of the thermological examination in cases of chronic pain investigation:

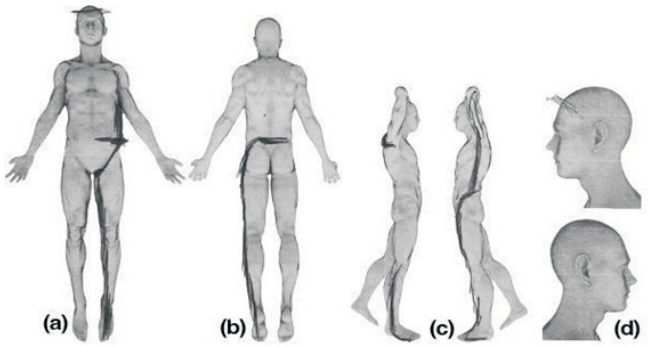

Figure 4:
pain map filled out by the patient as part of the pain and thermological clinic examination.

As can be seen in the pain map (Figure 4), in addition to the patient's main complaint of chronic testicular pain, which was rated 4 on the verbal pain scale at the time of the examination, he also highlighted lesser intensity pains that he was able to live with in other parts of his body. It is important to note that the patient categorically stated that in the morning (when the infrared thermography tests are performed by the doctor), his pain was completely tolerable, but reached a score of 9 by evening (worsening progressively throughout the day), requiring him to use medication to sleep because the testicular pain prevented him from falling asleep. In addition to the painful condition, the patient reported that he was frequently awakened during the night due to involuntary movements of his left lower limb. Additionally, the patient indicated on the pain map a tolerable pain in the lumbar region (Figure 4-a), inguinal and left hip (Figure 4-a), thigh and medial leg extending to the foot(Figure 4-a), and discomfort in the flank and left lateral chest (Figure 4-b). It is worth noting that the dorsal image (Figure 4-b) has a lateral marking of pain.

However, the patient explained that the pain did not travel laterally down the leg, but he wanted to show that the pain was in the left leg. This statement can be verified by the way the patient represented his pain in the left lateral drawing (Figure 4-c).

In the thoracolumbar region, although there are no consistent data in the medical literature to support this, attention was drawn to the apparent thermographic asymmetry paraspinal to the left and relatively lower infrared radiation in the left hip region (Figure 5) when compared to the contralateral side. The physician responsible for investigating the pain empirically performed a moderate intensity mechanical compression test on the area of higher hy- perradiation using a tennis ball (in the topography marked as LEFT in Figure 5). Interestingly, with compression, the patient reported an aggravation of scrotal pain, in addition to a pulling sensation in the topography of the proximal medial thigh to the left. This was the first clue that the region suggested by thermography could be directly or indirectly related to the patient's chronic scrotal pain. Compression on the other side did not elicit any painful symptoms.

After the initial findings and during a subsequent medical appointment, the patient, who remained skeptical that the pain in his scrotum could have a distant origin from the site of the pain, requested a repeat mechanical stimulation test. Once again, compression of the left paraspinal lumbar region, this time with the fingertip, elicited testicular pain that was reported as "slightly more intense" than during the previous test.

Assuming that standard urological diagnostic methods for chronic testicular pain had been extensively applied and that inguinal injuries and L1 and L2 radiculopathy could be related to the patient's reported pain [1, 33], IRT was used to identify thermographic asymmetries that could provide clues to autonomic dysfunctions associated with these con-

ditions. Considering that thermographic asymmetry could indicate abnormality, even if not identified by consistent absolute temperature terms, two regions of asymmetry were suggested: the less radiant left inguinal region (Figure 1) and a small area in the left paraspinal thoracolumbar region that was more radiant (Figure 3). Both areas indicated empirical thermographic asymmetries in topographies already known in urological practice as sources of chronic scrotal pain: inguinal hernias that could cause scrotal pain [33, 55] and their surgical correction that could lead to resection of the genital branch of the genitofemoral nerve [55, 56, 57], and radiculopathies in the L1 and L2 regions [1, 54, 58].

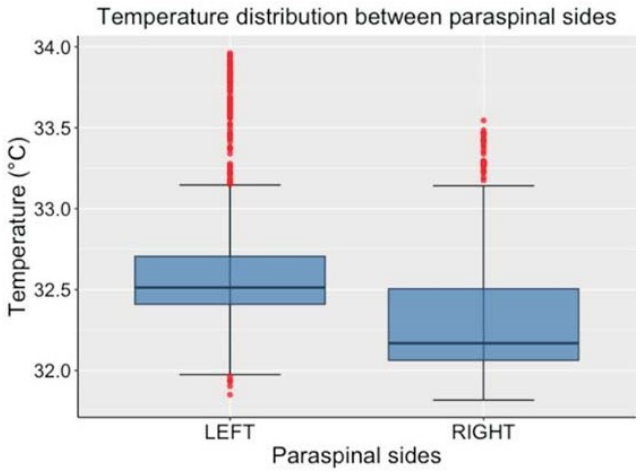

Figure 6:
side-to-side difference in the thoracolumbar area.

Subsequently, after observing a positive response to mechanical stimulation in the more radiant asymmetrical area in the left thoracolumbar paraspinal region, efforts were made to further characterize the apparent thermographic asymmetry. To achieve this, the ResearchIR+ software (FLIR®, FLIR Research IR Max 4.4. 2017, FLIR® Inc) was used to extract the set of temperatures from the thermal matrix of the LEFT and RIGHT regions of interest (ROIs) (Figure 5). Both ROIs were of the same dimensions (26 x 18 pixels), comprising a total of 468 measurements each, centered on the most medial points of each side. Using the R programming language [59], a comparative graph was generated between the temperatures of the two ROIs in question (Figure 6). The Anderson-Darling normality test (95% CI) indicated non-parametric samples (p =2e-16) and, by applying the Wilcoxon Test (95% CI) for non-parametric samples, it was found that there is a statistically significant difference between the two samples (p = 2e-16), with an average temperature difference (ΔTavg) of 0.36°C.

Discussion

Among the methods used to measure human body temperature, infrared thermography (IRT) is the only one that allows obtaining the thermal profile of Regions of Interest (ROI) between thousands of thermal points (or thermal pixels) [34]. Since 1950, initially intended for military industry, the use of IRT has gained ground as equipment has become more efficient, safe, reliable, and cheaper [35, 36]. Its application in healthcare has become increasingly diversified, becoming applicable in various involved areas. When compared to other imaging methods, this technique shows better performance in the etiological approach to pain, both acute and chronic, obtaining greater sensitivity and specificity when additional provocative tests are used [37, 38, 39, 40]. In addition, IRT stands out as a method for functional evaluation of the autonomic nervous system, revealing the neurological dysfunctions that have repercussions on the microvascular circulation of tissues, especially when addressing the skin [41].

In this report, the analysis of the thermograms was based solely on the empirical thermographic asymmetry between the sides - this being the most classical parameter used.

Such analysis consists of the temperature difference (ΔT or other asymmetry parameter) in relation to the contralateral side [42]. The central control of cutaneous temperature affects both sides of the body uniformly and simultaneously, resulting in almost symmetrical thermal patterns after stabilization in a thermally stable environment. In a study conducted by Uematsu [43] on facial, trunk and extremity temperatures in normal individuals, cutaneous temperature in 32 segments on the right and left sides of the body were symmetrical. Zhang et al. [12] found that, depending on the region of the upper limbs, for example, values greater than the range of 0.1°C to 0.4°C could be classified as abnormal. When the difference is greater than 1.0°C, the condition can be interpreted as significant [43, 44, 45]. However, under certain conditions, values lower than 1.0°C can also be significant [46]. Some variations of this parameter, for instance, can be used in the evaluation of breast cancer, such as the thermal difference between the mean of the Region of Interest (ROI) and a point outside the ROI [47]. The systematic application of such temperature differences for the diagnosis of neuromuscular disorders by IRT was introduced in 1973 by Duensing et al. [48]. In this study, temperature changes were correlated with the sensory distribution of nerves in lumbosacral radiculopathies. Subsequent studies reported a direct correlation between painful conditions and abnormal infrared patterns [49, 50, 51], as well as a correlation between pain intensity and thermal asymmetry [12, 52].

It is well known, according to the international medical literature, that the testicles develop embryologically in the upper abdomen and descend to the scrotum shortly before birth. This descent is accompanied by the testicles' sympathetic nerve supply from the T10 to L1 segments and parasympathetic nerve supply from S2 to S4 [33, 53, 54]. The somatic supply to the testicles and scrotum originates from the nerve roots of L1-L2 and S2-S4 via the iliohypogastric, ilioinguinal, genitofemoral, and pudendal nerves [33]. The genitofemoral nerve is formed by the merging of branches from the L1 and L2 spinal roots, and it bifurcates into the genital and femoral branches after passing through the psoas muscle.

According to Uematsu [61], temperature differences between the dorsal-lumbar halves less than 0.24±0.073°C are considered normal. Thus, it was statistically inferred that there was thermal asymmetry between the LEFT and RIGHT ROIs.

Conclusion

Medical literature suggests that evaluating chronic pain in the scrotal contents can pose a challenging and frustrating task for healthcare providers, given the multifactorial etiology of this condition. In this case report, thermographic asymmetry, a fundamental principle of Infrared Thermography, was empirically used to identify potential autonomic asymmetries in regions of interest, based on knowledge of neuropathic etiologies of chronic scrotal pain. Mechanical compression of the suspected areas, initially focusing on the apparent thermographic asymmetry in the left thoracolumbar topography and subsequent triggering of scrotal pain, suggested a possible radicular origin for the painful condition. Perhaps in future studies, identifying paravertebral thermographic patterns and correlating them with medically and scientifically recognized radiculopathies could aid not only in clarifying conditions such as this but also in other types of chronic pelvic and extremity pain with a likely radicular bias almost immediately through Infrared Thermography.

Patient Perspective

As stated by the patient, just the fact of having a diagnostic pathway, even though it might be improbable as a layman, was already a relief factor for his suffering. He could no longer live with a persistent condition that compromised his daily routine and sleep, after several complementary exams, and it was not enough for him to receive from the doctor the diagnosis that he "had nothing out of the ordinary".

Informed Consent

After obtaining clarifications, the patient provided voluntary consent for the use of their clinical-epidemiological data and thermal images, under the condition of maintaining anonymity. This consent was documented through a formal agreement signed by the patient and delivered to the principal researcher.

Conflicts of Interest

The authors declare no conflicts of interest.

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2023

20th - 22nd October 2023
Virtual AAT 2023 Annual Scientific Session

Website: https://annualmeeting.aathermology.org

About The Event

The 2023 Annual Scientific Session will be a Virtual Meeting consisting of both recorded presentations and live sessions. Those who register for the full meeting with next year's membership will be given 60 days post-meeting access to the recorded presentations.

Separate registration is required for the Pre-Meeting Physician's Thermography Interpretation and the Getting Started Courses. The Interpretation course is on line, at your own pace, followed by a Virtual Live question and answer session conducted between 9:00am and 12:00pm (Eastern Time) on Friday, October 20th, 2023.

The getting Started course is Virtual Live format only.

It runs from 2:00pm to 5:00pm, on Friday, October 20th, 2023

2023 Conference Schedule

- Day 1

Pre-Meeting Sessions (separate registration required):
Friday, October 20th, 2023

9:00 am - 12:00 pm
Virtual Live Physician Interpretation Q & A Session
By Robert Schwartz, MD AAT COB, Greenville, SC

2:00 pm - 5:00 pm
Virtual Live "Getting Started In Medical Thermology"
Round Table
By Jan Crawford, RN, BSN AAT Board, Scaly Mt, NC, Robert Kane, DC AAT Member, San Francisco, CA, Robert Schwartz, MD AAT COB, Greenville, SC

- Day 2

General Sessions:
Saturday, October 21st, 2023

7:45 am
Virtual Log In Opens
Registration would be started by 8:00 am.

8:00 am - 10:00 am
Updates In Medical Thermology

8:00 am - 8:20 am
Medical Thermology In The New Normal
By Robert Schwartz, MD, AAT COB, Greenville, SC

8:20 am - 8:40 am
AAT Executive Director's Report
By Kathy Sullivan, PhD; AAT Executive Director, Eagan, MN

8:40 am - 9:00 am
Will Medical Thermology Follow The Path Of Radiation Oncology?
By Jonanthan Gershenson, DO; AAT Board Member, Sacramento, CA

9:00 am - 9:20 am
Updates In The AIIR AI Research Protocol
By Ho Yeol Zhang, MD, PhD NHIS Ilsan Hospital, Seoul, Korea

9:20 am - 9:40 am

Applied Physics In Medical Thermology

By Francisco "Paco" Renero, PhD; AAT Member, Tonantzintla, Mexico

9:40 am - 10:00 am
Expert Panel 1 - Updates In Medical Thermology Q & A

10:00 am - 12:00 pm
Clinician's Corner: Neuromusculoskeletal Thermology

10:00 am - 10:20 am
Updates in Thermology and Pain Medicine-Part 1
By Behnum Habibi, MD; AAT Board, Philadelphia, PA

10:20 am - 10:40 am
Updates in Thermology and Pain Medicine-Part 2
By Behnum Habibi, MD; AAT Board, Philadelphia, PA

10:40 am - 11:00 am
Medical Thermology For The Dysautonomic Patient
By Matthew Terzella, MD; AAT Board, Greenville, SC

11:00 am - 11:20 am
Medical Thermology For Facial, Orbit & Eye Pain

By Anat Galor, MD; AAT Member, Miami, FL

11:20 am - 11:40 am
IR Thermology For Sports Injury Restorative Therapy
By Ismael Fernandez, PhD; AAT Member, Madrid, Spain

11:40 am - 12:00 pm
Expert Panel 2 - NMSK Q & A

12:00 pm - 1:00 pm
Lunch

1:00 pm - 3:00 pm
Clinician's Corner: Veterinarian Thermology

1:00 pm - 1:25 pm
How To Perform Field Thermographic Imaging
By Ken Marcella, DVM; AAT Member, Canton, GA

1:25 pm - 1:50 pm
Thermology As A Proactive Screening Tool In Companion Animals
By Ronald Riegel, DVM; AAT Member, Marysville, OH

1:50 pm - 2:15 pm
Thermology In Working Canine Harness Evaluation
By Kim Henneman, DVM; Park City, Utah

2:15 pm - 2:40 pm
Thermography-Assisted Lameness Management for Giraffes
By Liza Dadone, DVM; Colorado Springs, CO

2:40 pm - 3:00 pm
Expert Panel 3 - Veterinarian Q & A

3:00 pm - 5:00 pm
Clinician's Corner: Breast Thermology

3:00 pm - 3:30 pm
The Impact Of Heat Diffusion Analysis In Breast Thermology
By Jonanthan Gershenson, DO; AAT Board Member, Sacramento, CA

3:30 pm - 3:50 pm
The Importance of Nipple Temperatures in Breast Thermography
By James Stewart Campbell, MD; AAT Senior Member, Pfafftown, NC

3:50 pm - 4:10 pm
AAT's Response To FDA's Required Dense Breast Notifications
By Jonanthan Gershenson, DO; AAT Board Member, Sacramento, CA

4:10 pm - 4:30 pm
Breast Thermology Publications
By Robert Kane, DC; AAT Member, San Francisco, CA

"4:30 pm - 5:00 pm
Expert Panel 4 - Breast Thermology Q & A

"5:00 pm
Saturday Session Ends

"5:00 pm - 6:00 pm
Virtual Meet and Mingle Reception

- Day 3

General Sessions and Annual Business Meeting:
Sunday, October 22nd, 2023

"8:00 am

Virtual Log In

"8:10 am - 10:00 am
Clinician's Corner: Oral-Systemic Thermology

8:10 am - 8:30 am
Computer Driven Thermographic Algorithms For Diabetic Foot Ulcers
By Mershari Alwashmi, PhD; AAT Member, San Francisco, CA

8:30 am - 8:50 am
Point of Care Thermography and Venous Disease
By Ariel Soffer, MD; AAT Member

8:50 am - 9:10 am
Limitations and Considerations of Infrared Thermology for Injury Assessment in Sports: A Critical Review
By Marcos Brioschi, MD, PhD AAT Member, ABRATERM. Sao Paulo University, Brazil.

9:10 am - 9:40 am
Expert Panel 5: Oral-Systemic Q & A

9:40am - 11:00 am
Practice Development

9:40 am - 10:00 am
The True Problem of Artificial Intelligence in Medical Thermography: A Critical Analysis
By Marcos Brioschi, MD, PhD AAT Member, ABRATERM. Sao Paulo University, Brazil.

10:00 am - 10:20 am
Update On Forensic IR Program Development
By Brian Bennett Columbia, SC

10:20 am - 10:40 am
Media and Marketing For Program And Practice Growth
By Stepahnie Acker , AAT Media Specialist, Greenville, SC

10:40 am - 11:00 am
Panel 6: Practice Development Q & A

11:00 am
General Session Ends

11:00 am - 1:00 pm
Board of Directors Meeting (Board Members Only)

30th October-November 3rd Abu Dhabi, UAE QIRT Asia Conference

The conference, 4th QIRT Asia 2023 will be held in Abu Dhabi, United Arab Emirates

Website: https//qirt-asia-2033.org

The biannual Quantitative InfraRed Thermography (QIRT) Conference is a meeting of the scientific and industrial community interested and actively working in research, application, and technology related to infrared thermography. All conference topics are intended for quantitative results comprising temperature values as well as further parameters on the tested materials and structures. The latter ones are usually obtained through active thermography, e. g. by exploiting non-stationary heat transfer processes activated by additional heat sources or by considering wavelength-dependent effect

Venue

The conference will be held at Khalifa University, Abu Dhabi, U.A.E

List of Topics

- Applications of AI and CNN
- **Biomedical applications**
- Calibration and metrology
- Civil Engineering and Buildings
- Electronics and semiconductors
- Environment
- Fluid dynamics and energetics
- Image and data processing
- Induction thermography
- Industrial applications
- IR signature, Image Processing and Recognition
- Microscale applications
- Modeling
- Monitoring and maintenance
- NDE and its applications to composite structures
- Novel technique
- Photothermal techniques
- Remote sensing
- Thermographic Systems & Components
- Thermomechanics
- Vibrothermography
- Works of Art

CALL FOR ABSTRACTS

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

XVI Congress of the European Association of Thermology

6th – 8th September 2024

Faculty of Biology and Animal Science

Wrocław University of Environmental and Life Sciences

Wrocław, Poland

XVI Congress of the European Association of Thermology

Wrocław POLAND 2024

www.eurothermology.org/XVICongress.html

The EAT and Wrocław University of Environmental and Life Sciences are delighted to invite you to participate in the XVI EAT Congress in Wrocław, Poland from 6th to 8th September 2024.

The European Association of Thermology exists to promote, support and disseminate research in thermometry and thermal imaging in the fields of human and veterinary medicine and biology. We do this through our peer-reviewed journal Thermology International, regional seminars around Europe, and our flagship Congress, which takes place every three years.

Following on from the most recent meetings in Porto (2012), Madrid (2015), London (2018) and online (2021) the Congress heads to eastern Europe for 2024 to Wrocław in Poland.

The Organising Committee looks forward to welcoming you to Wrocław University of Environmental and Life Sciences in the summer of 2024.

Dr. Kevin Howell
EAT President

VENUE.

Wroclaw lies on the banks of the River Oder in western Poland, and is the capital of the Lower Silesian Vovoideship. It was the European Capital of Culture in 2016, and won the "European Best Destination" title in 2018.

Our venue will be the Faculty of Biology and Animal Science at the prestigious University of Environmental and Life Sciences on Chelmonskiego Street in the eastern suburbs of Wrocław. The Faculty building boasts excellent conference facilities including a large lecture theatre, ample lobby space for networking and poster presentations, and a spacious restaurant for lunch breaks. This is the perfect environment for delegates to present their thermological research at Europe's flagship biomedical temperature congress.




ORGANISING COMMITTEE

Maria Soroko-Dubrovina (POL), Chair

Kurt Ammer (AUT)
Kevin Howell (GBR)
Anna Jung (POL)
Adam Roman (POL)
Adérito Seixas (POR)
Manuel Sillero-Quintana (ESP)
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Maria Soroko-Dubrovina (POL)
Hisashi Usuki (JPN)
Ricardo Vardasca (POR)

KEY DATES.

Abstract submission will open online on 4th September 2023, and authors will be notified of acceptance for oral or poster presentation by 4th March 2024.

May 2023. Publication of the First Announcement.
31st July 2023. Publication of the "Call for Abstracts" document.
4th September 2023. Opening of abstract submission and registration.
15th January 2024. Abstract submission deadline.
4th March 2024. Acceptance notification to authors.
6th May 2024. End of Early Registration and deadline for registration of presenting authors.

REGISTRATION FEES (*)

	Early Registration (Until 06 MAY 2024)	Late Registration (After 06 MAY 2024)
EAT MEMBER	€360	€410
Non-Member	€440	€490
One-day registration	€200	€250
Student	€200	€250
Accompanying person	€120	€120

(*) Further information about the registration process is online at www.eurothermology.org/XVICongress.html Registration includes access to all congress sessions, congress lunch and coffee breaks, the Gala Dinner, and other congress social programme events.

ACCOMMODATION

Recommended hotels:

1. **Hotel ZOO**

Address: ul. Wroblewskiego 7, 51-627 Wroclaw

website: http://zoo-hotel.pl/

2. **Radisson Blu Hotel Wroclaw*****

Address: ul. Purkyniego 10, 50-156 Wroclaw

website: https://www.radissonblu.com/pl/hotel-wroclaw

3. **Grape Hotel & Restaurant*****

Address: Parkowa 8, 51-616 Wroclaw

website: https://www.grapehotel.pl

4. **PURO Wroclaw Old Town*****

Address: Pawła Włodkowica 6, 50-072 Wroclaw

website: https://purohotel.pl/pl/wroclaw

5. **HOTEL EUROPEUM *****

Address: ul. Kazimierza Wielkiego 27A, 50-077 Wroclaw

website: https://europeum.pl

6. **Hotel Mercure Wroclaw Centrum******

Address: pl. Dominikański 1, 50-159, Wroclaw

website: https://www.accorhotels.com/pl/hotel-3374-hotel-mercure-wroclaw-centrum/index.shtml

ACCOMPANYING PERSONS

All accompanying persons will be invited to join the Congress Gala Dinner and full social programme upon payment of the appropriate €120 fee.

KEY MEETING THEMES

- Infrared thermography in biomedicine.
- Temperature measurement in animal welfare, veterinary applications and equine physiology.
- Contact temperature measurement.
- Hardware and software solutions for infrared imaging.
- Biomedical applications: surgery, neurology, vascular and pain syndromes.
- Thermometry in exercise physiology, rehabilitation, and human performance research.
- Calibration and traceability in biomedical thermometry.

ABOUT WROCŁAW

Wrocław is also called "The Venice of the North" due to the fact that, after Amsterdam, Venice and St. Petersburg, it has the biggest number of bridges and footbridges in Europe.

Notable landmarks include the 10th century Cathedral, the Centennial Hall from 1913 (one of the UNESCO world heritage sites), and the distinctive architecture of the Town Hall and Market Square. Wrocław is also host to the Racławice Panorama, a 114m-long cycloramic painting from 1894, commemorating the 100th anniversary of the Battle of Racławice. In recent years Wrocław has also become well-known for its “little people” or “dwarves”: small figurines scattered across the city streets which were first conceived as part of the city’s anti-communist movement in 2005. These now number more than 350, and can be located with the help of a dedicated tourist map. Wrocław Zoo, close to our congress venue, is the oldest zoo in Poland, and the third largest zoological gardens in the world in terms of the number of species on display. In summertime, large numbers of visitors are attracted at night to Wrocław’s “Multimedia Fountain” close to the Centennial Hall. This is one of the largest operating fountains in Europe, and stages dramatic light shows set to music.

TRAVEL

COPERNICUS AIRPORT WROCŁAW is about 10 km from the city centre, and connects Wrocław with Warsaw, Gdansk, and destinations throughout Europe. From the airport you can reach the city centre by a shuttle bus (journey time about 30 minutes), or by bus No. 106, which leaves every 15 minutes (journey time about 40 minutes) or by taxi. Wrocław's main rail station, WROCŁAW GŁÓWNY, connects the city to other major destinations across Poland and eastern Europe. Wrocław's central bus station is located at 1/11 ul. Sucha, adjacent to the main railway station, and connects the city by road to all major Polish and European destinations.

Preliminary Schedule.

XVI Congress of the European Association of Thermology, 6th – 8th September 2024, Wrocław University of Environmental and Life Sciences.

Time	Friday	Saturday	Sunday
8.30	Course Registration	Congress registration	Morning session 1 followed by prizegiving, close of congress
9.00 - 10.30	Short Course on Medical Thermography	Morning session 1	
10.30 - 11.00		Coffee break	Coffee break
11.00 – 12.30		Morning session 2	EAT General Assembly
12.30 – 13.00		Poster viewing	
13.00 – 14.00		Lunch	
14.00 – 15.30		Afternoon session 1	Tour around Wrocław's Old Town and Ostrów Tumski
15.30- 16.15		Tea break	
16.15 – 18.00		Afternoon session 2	
18.30 – 20.00	Congress registration		
19.30- 22.00		Gala dinner	

European Association of Thermology

Short Course on Medical Thermography

Friday 6th September 2024, Wrocław University of Environmental and Life Sciences Wrocław, Poland

Following on from successful courses in Porto, Madrid, London, and online in 2021, the next EAT Short Course on Medical Thermography will take place immediately prior to the EAT 2024 Congress in Wrocław, Poland. The course aims to deliver a thorough introduction over one full teaching day to basic thermal physiology and the principles of infrared thermography for human body surface temperature measurement. It will be taught by an experienced faculty of EAT clinicians, biomedical researchers and imaging scientists. Aspects of reliable thermogram capture will be demonstrated in a laboratory session, and students will have the opportunity to practice thermal image analysis in a supervised "hands-on" session.

Syllabus

- Physical principles of heat transfer
- Principles of thermal physiology/skin blood perfusion
- Standardisation of thermal imaging, recording and analysis
- Quality assurance for thermal imaging systems
- Producing a thermographic report
- Provocation tests
- Image analysis
- Hands-on supervised practice
- Educational resources

Registration

The course fee (inclusive of lunch and coffee breaks) is €220

Register from 1st January 2024: details online at www.eurothermology.org/education.html

Questions? Contact the EAT at eurothermology@gmail.com