

## Thermographic Imaging for Interventional Pain Management

*Kamayni Agarwal, Peer-Severin Spyra, Helge Beck*

*Division of Pain Management, Department of Anesthesiology, University Medical Center Hamburg-Eppendorf*

---

### ABSTRACT

Measuring pain intensity is a major objective in pain therapy. Unfortunately, we have not been able to develop tools to do so until today, hence, it is very difficult to judge if the therapy offered to a patient is effective or not. In certain states of pain, i.e. neuropathic and sympathetically maintained pain, blocks to the sympathetic nervous system are effective. They may provide dramatic relief to patients, though there is no way of demonstrating whether the alleviation results from blocking other structures than the sympathetic nervous system. Since the sympathetic trunk is involved in the regulation of skin blood flow, a rise in the skin temperature is anticipated when performing sympathetic blocks. The pattern of changes in skin temperature provides us with precious information on the success of the intervention next to the patient's subjective impression.

### INTRODUCTION

There is a demand for tools that rate pain intensity and alleviation after procedures applied in pain therapy. Ideally, these procedures are objective, patient-independent, and may be performed easily, without causing further harm to the patient's health. Pain scores have been developed with graphic description of pain intensity that are already being utilized. In these cases, physicians have to rely on patient statements that are often misleading and/or impaired due to emotional and affective components in pain perception.

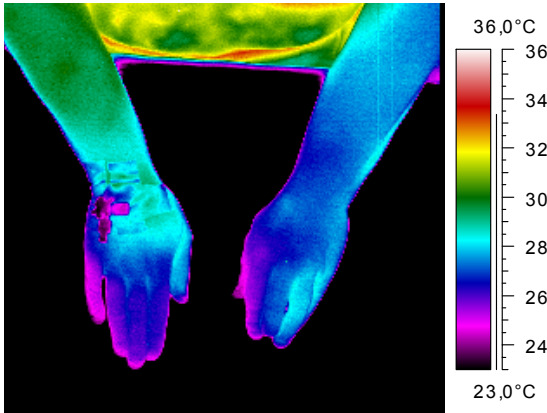
Some pain syndromes are not initiated or maintained by the somatic nervous system, which is normally involved in conveying information on damage to the organism, generating pain. As for neuropathic and sympathetically maintained pain, the autonomous nervous system is the main transmitter. Its activity can be visualized with thermal imaging, since it is responsible for cutaneous blood flow as well as other activities. Thermography may serve as a diagnostic tool in rating the efficacy of blocks of the autonomous nervous system.

Contact-free infrared thermography is a rarely applied diagnostic tool, although it may depict physiologic changes that cannot be demonstrated by ultrasound, CT or MR imaging. It is a non-invasive imaging technique that allows for the visualization of small cutaneous temperature alterations. Little data is available concerning a detailed methodology. Evaluating the effect of Interventional Pain Management requires specific tests to monitor sympathetic function. Common techniques include sweat tests, tissue oxygen analysis and Doppler flowmetry. Thermography also allows the practitioner to view the area from many different perspectives, adding to their knowledge.

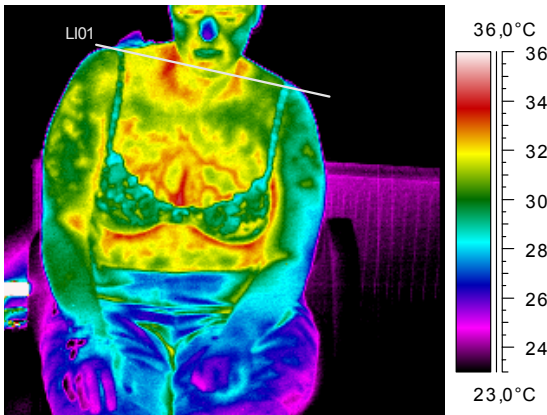
Our department's main focus is in the treatment of neuropathic and sympathetically maintained pain. As a result, thermography has become a precious tool for proving the efficacy of a procedure in order to decide whether neuroablation is indicated following a strict algorithm. On the day of admission, patients thought to suffer from sympathetically maintained pain undergo initial thermographic imaging (Inframetrics Model ThermaCAM PM390). They are placed in a room at 24.2-24.5°C for 30 minutes, along with a device to acclimatize them before imaging is performed. On the next day, the procedure is performed and imaging is carried out again after acclimatization for 30 minutes at 24.5°C. This procedure is repeated 30 min, 60 min and 180 min after administering high dose local anesthetic as a single shot or via a catheter that allows for the continuous infusion of local anesthetics. Dramatic changes in skin temperature are evident if pain is maintained sympathetically, and if the catheter sits in the right position separated from the patient describing their pain alleviation. In the case of catheter dislocation, thermal imaging detects it easily, without exposing the patient to x-ray or other invasive diagnostic procedures.

## INITIAL MEASUREMENT

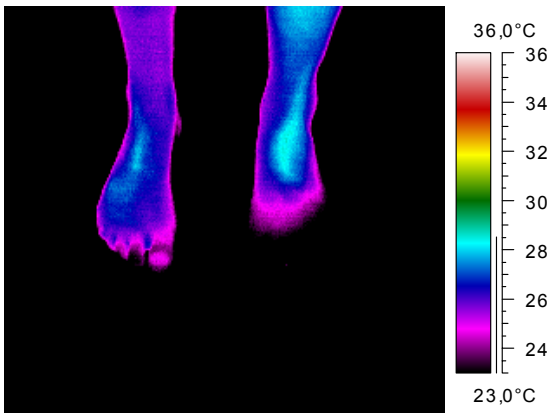
According to the nature of the underlying disease, infrared imaging is performed on the day of hospital admission in a special setting, according to the American Association for Thermology. Here, we would like to present imaging of two different patients: first, a 26 year-old female who presented with CRPS (Complex Regional Pain Syndrome) of the left arm. In this particular case, posture was also assessed in order to be able to judge efficacy of treatment. The second patient presented with CRPS of the right foot.



*Figure 1. Thermogram of the hands prior to Interventional Pain Management*

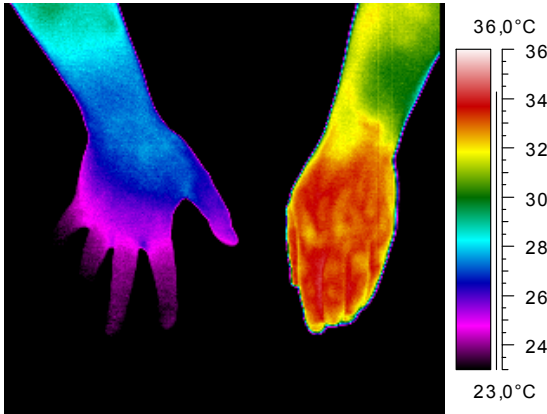


*Figure 2. Thermogram of the upper body prior to Interventional Pain Management. Notice tilting of the shoulder girdle*

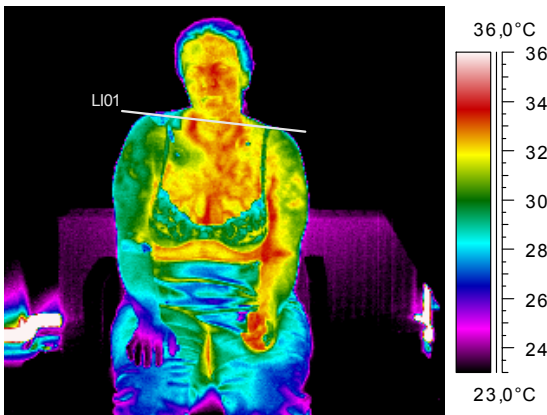


*Figure 3. Thermogram of the feet prior to Interventional Pain Management*

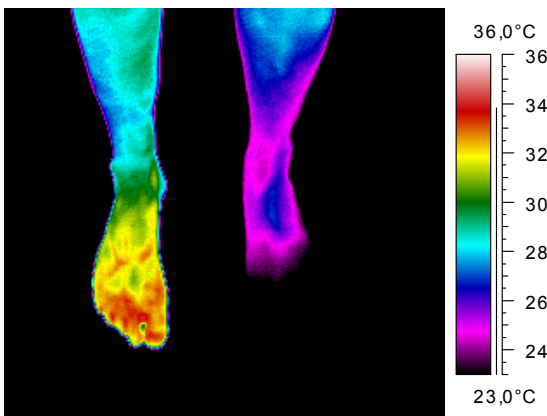
After the intervention is performed, pictures are taken to visualize the effect of the procedure. Imaging of the first patient shows her after one week of treatment with Interventional methods. Note the rise in temperature of the left hand and the decreased tilt of the shoulder girdle. The second patient shows a rise in temperature of her unaffected right foot, while the affected left foot couldn't be reached with the procedure we performed. Pictures were taken 30 minutes after intervention. Note that in this case, the desired effect was achieved via the sympathetic nervous system – imaged as a rise in temperature of the right foot. However the syndrome was obviously not maintained by this part of this nervous system, as the ill left foot could not be treated.



*Figure 4. Thermogram of the hands after continuous block of the thoracic sympathetic chain for one week*



*Figure 5. Thermogram of the shoulder girdle after continuous block of the thoracic sympathetic chain for one week*



*Figure 6. Thermogram of the feet 30 minutes after block of the lumbar sympathetic chain*

## **SUMMARY**

Thermographic imaging is a precious tool in order to prove the effects of pain therapy in sympathetically maintained pain. Next to the information on the surface temperature, posture may also be monitored.

## **REFERENCES**

Yen, LD, Bennett GJ, Ribeiro-Da Silva, A: Sympathetic Sprouting and Changes in Nociceptive Sensory Innervation in the Glabrous Skin of the Rat Hind Paw Following Partial Peripheral Nerve Injury. J Comp Neurol (2006) 495:679-690

## **ABOUT THE AUTHORS**

Kamayni Agarwal and Helge Beck are anesthesiologists specialized in pain therapy focusing on Interventional Pain Management of neuropathic, sympathetically maintained and malignancy associated pain. They have been using infrared thermography for the past 16 years. Peer-Severin Spyra is a medical student who acquired above mentioned data for his thesis.