17th Congress of the Polish Association of Thermology and Certifying course: "Practical application of thermography in medical diagnostics"

Zakopane, March 15th - 17th, 2013

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Conference venue:

Hotel "HYRNY"
Zakopane, Pilsudskiego str 20

Organizers

Paediatric,Nephrology and Alergology Clinic
Military Institute of Medicine, Warsaw, Poland
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Scientific Programme

Saturday, March 15th 2013

09:50 - 11:00 Session I
Chairmen: Prof. Francis Ring, Prof. Anna Jung

1. Ring F. (*UK*)- The Herschel legacy of infrared imaging.

2. Mercer JB., Lokebo JE, de Weerd L(*Norway*) - Thermography as an adjunct with other imaging modalities to evaluate the perfusion of freezing cold injuries.

3. Vardasca R, Silva A, Seixas A, Gabriel J. (*Portugal*)- Medical thermal imaging technological assited lab.

4. Ammer K. (*Austria)* - Publications on Thermology between 1989 and 2012.

11:00 - 11:30 Coffee break

11:30 - 13:00 Session II
Chairmen: Prof. James Mercer , Prof. Boguslaw Wiecek

1. Strakowski R, Wiecek B. (*Poland*)- Review on multispectral thermography and its applications in biomedicine.

2. Rustecki B, Jung A, Kalicki B, Murawski P, Rustecka A, Zuber J. (*Poland*) - Esophagus measured central temperature compared with infrared camera temperature in patient under general anesthesia - preliminary study.

3. Badaro J, Lima M, Araujo J, Marcondes A, Brioschi M, Teixeira M, Vardasca R (*Brazil*) - Thermographic evaluation of migraine.

4. Strakowska M, De Mey G, Wiecek B, Wittchen W, Marzec S. (*Poland*) - Thermal transient thermography for human skin modelling and screening.

5. Urakow AI, Urakowa NA. (*Russia*) - Thermography of the skin as a method of increasing local injection safety

13:00 - 14:00 Lunch

14:30 - 16:00 Session III
Chairmen: Prof. Kurt Ammer , Dr Kevin Hovell

1. Kasatkin AA.(*Russia*)- Effect of drugs temperature on infrared spectrum of human tissue.

2. Brioschi M, Teixeira M, Yeng L, Franco G, Araujo J, Lima M, Marcondes A, Freitas P, Badaro J. (*Brazil*)- Comparison clinical, ultrasound and thermography points in identifying myofascial.triggers in patients with fibromyalgia

3. Boguszewski D, Adamczyk J, Slupik A, Mosiolek A, Bialoszewski D. (*Poland*) - Usage of thermovision in evaluation of influence of sports massage on selected biomechanical and physiological parameters of lower limbs.

4. Adamczyk J, Boguszewski D, Siewierski M., Bialoszewski D. (*Poland*) .- Relations between thermal portrait and aerobic capacity - evaluation of thermoregulation efficiency throughout thermovision.

5. Soroko M, Henklewski R, Filipowski H, Jodkowska E.(*Poland*) - The effectiveness of thermographic analysis in equine orthopaedics.

16:00 - 16:15 Coffee break

16:15 - 17:00 Training course

Chairmen: Dr med. Boleslaw Kalicki

1. Ring F., Ammer K .(*UK/Austri*a) - Errors and artefacts in infrared imaging.

2. Wiecek B. (*Poland*) - The useness of thermal impedance concept in medical thermography.

3. Firm presentation.

17:00 - 18:30 EAT Committee Meeting

Sunday, March 17th 2013

09:30 - 11:00 Session IV
Chairmen: Dr Ricardo Vardasca, Dr med. Janusz Zuber

1. Urakowa NA.(*Russia*) - Decrease of the temperature of the head of the fetus during birth as a symptom of hypoxia

2. Naseer S, Keresztes KG., Coats TJ .(*UK*) - Developing a thermal imaging protocol for use in emergency care environment.

3. Seixas A, Silva A, Mendes JG, Vardasca R. (*Portugal*)- The effects of whole-body vibration on thermal symmetry of the lower legs in healthy subjects.

4. Murawski P, Jung A, Kalicki B, Rustecki B. (*Poland*) - Usefullness of Linear Predictive Coding coefficients for the qualification healthy people and patients with sinusitis based on facial thermograms.

5. Cholewka A., Stanek A., Kwiatek S., Siero? A., Drzazga Z. (*Poland*) - Does the temperature correlate with photodynamic diagnosis parameter numerical colour value (NCV)?

Abstracts

THE HERSCHEL LEGACY OF INFRARED IMAGING

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There are many references to the fact that Infrared radiation was identified by William Herschel in England in 1800. In the Philosophical Transactions of The Royal Society London in 1800 a series of papers can be found that relate to the properties of sunlight. In the famous experiment to discover the source of heat sometimes recognised by Herschel using his own optical systems for telescopes he attempted to measure the temperature of each colour of the optical spectrum using a prism in a darkened room, and placing thermometers in the path of each displayed colour. To his surprise he found the only increase in temperature occurred outside the visible colours, beyond the red. He called this dark heat, now known to us as infrared radiation. There are many more observations beside that fundamental discovery, and Herschel compared the properties of both light and heat. He noted that heat rays could be reflected and focussed and that a number of substances in solution acted as filters reducing the energy when heat rays were passed through them, similar to those of visible light. It was also important that in 1840 shortly after his father's death that his son John Herschel made an experiment to record heat from the son by an evaporation process with alcohol and carbon particles in suspension. This created an image over a period of several hours that he called a thermogram. Today in the 21 century we are using infrared images in a wide range of applications both medical and industrial. Significant advances have been made in recent years in infrared astronomy. Here the very subject that brought William Herschel to investigate heat, remarkable technology is now used to study the cosmos using infrared imaging and spectroscopy. This paper will overview some of the more recent findings using satellite spacecraft to carry multispectral imaging telescopes beyond the earth's atmosphere to study the very origins of the Universe.

THERMOGRAPHY AS AN ADJUNCT WITH OTHER IMAGING MODALITIES TO EVALUATE THE PERFUSION OF FREEZING COLD INJURIES

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There is little international consensus on the management of freezing cold injuries (FCI) and treatment procedures vary from being aggressive (rapid amputation) to conservative (wait and see). The different approaches to treating such injuries can partly be explained by the complexity surrounding the injury. For example, with frostbite tissue freezing occurs which may involve only superficial tissues or may extend to the bone. The onset and severity of frostbite may be affected by a multitude of factors such as air temperature, wind speed, duration of exposure, amount of exposed area, and predisposing conditions such as poor or inadequate insulation from the cold or wind, immersion, altitude, impaired circulation from tight clothing or shoes, fatigue, injuries, circulatory disease, poor nutrition, dehydration, hypothermia, alcohol or drug use, and use of tobacco products. Damage to the frostbitten tissues is caused by crystallization of water within the tissues, typically between the cells, and by resulting changes in electrolyte concentration within the cells. Damage occurs during the freezing process. Further damage occurs during reperfusion of frostbitten tissue. Whatever the situation one of the key factors in recovery is adequate tissue blood perfusion. So whether one is interested in mapping the extent of such an injury in the acute phase or monitoring the effect of a treatment regime or assessing the final outcome, some form of blood perfusion measurement is desirable. An example of a multimodal imaging approach using CT angiography, MR, scintigraphy and thermography for investigating blood perfusion in a severe case of frost bite of the feet will be presented. It will be shown that thermography as a non-invasive method without the use of ionizing radiation was helpful in confirming the diagnosis, assessing the severity of the injury, and finally monitoring the outcome of FCI.

MEDICAL THERMAL IMAGING TECHNOLOGICAL ASSISTED LAB

Ricardo Vardasca[1,2], António Silva[1], Adérito Seixas[3,4], Joaquim Gabriel[1]

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Medical thermography has evolved since its first application in 1956 either with technological and protocol developments. Ammer in 2003 pointed to the need for standardisation in the medical thermal imaging to cope with the other medical imaging modalities used in daily clinical practice. Recommendations and guidelines for preparing the room environment, equipment and subject before and during the examination have been produced and used to increase and warranty the quality and the acceptance of the technique as valuable.

Some technological issues are still open for development such as dedicated software package making use of the most recent image processing algorithms and predefined views and other intrinsic aspects of Medical Thermography is missing, the development of the defined DICOM modality to accommodate the specific data from a simple or functional examination. Consequently there is a lack of a medical thermal imaging database to be used worldwide as a reference.

Currently there are assistive technologies that can help to improve the use of Medical Thermography contributing to a considerable decrease of the human error and operator dependency, which can be used to improve the quality and reliability of the method. Examples of those assistive improvements are the usage of environment variables sensors (air flow, humidity and temperature) in the stand where the IR camera is placed for examination. Sensors of distance, emissivity and angular position, with a touchscreen interface would assist the operator in using the technique correctly and to record the whole environmental relevant data at the moment of capture into the DICOM medical thermography modality definition. Having that information available in a PACS system, image analysis and reporting tools can be developed to be used by the current and future mobile systems as tablets and smartphones, which will contribute to a better satisfaction and convenience from the health professionals and patients.

A fully implementation of these concepts would put Medical Thermography at the same level of development of other medical imaging modalities and would significantly contribute to its credibility assurance leading to global widespread usage among health care professionals, filling the gap of six decades.

ACKNOWLEDGMENTS:

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PUBLICATIONS ON THERMOLOGY BETWEEN 1989 AND 2012

Kurt Ammer [1,2]

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In 1997, a CD ROM [1,2] was compiled at the University of Glamorgan containing all issues of the journal "Thermology" published by the American Academy of Thermology and almost all issues of "Acta thermographica" edited by Prof. G.F. Pistolesi. Both discontinued publications years ago. The journal "Thermology international" which started as "Thermologie Österreich" and changed its name "European Journal of Thermology" between 1997 and 1998, evolved as the main organ for publication of the thermological community.

Together with the proceedings of the 6th European Congress of Thermology, held in Bath in October1994, Thermology international is an important source of references which is supported by the fact that Reutters Web of Science lists 90 papers from Thermology international resulting in a total of 130 citations. Embase accepted to include full papers from Thermology international in 2002 and started to list conference abstracts in 2012. For the period from 2002 on, 369 citations were found in Embase/Scopus. Using Harzing´s Publish or Perish, a bibliography search tool based on Google Scholar, a total of 368 citations were obtained for 89 papers published in Thermology international. Searching for European Journal of Thermology in Google Scholar resulted in 65 citations for 19 papers. In my own archive, 229 cited papers - 95 published in Thermologie Österreich, 34 in the European Journal of Thermology and, 100 in Thermology international - received about 1050 citations.

In December 2012 a DVD-ROM became available including PDF-files of all issues of "Thermologie Österreich" (May 1991 to April 1997), "European Journal of Thermology" (July 1997to October 1998) and "Thermology international" (January 1998 to October 2012). Some papers such as "The Technique of Infra red Imaging in Medicine by E.F.J. Ring and K Ammer, Thermology international 2000; 10(1) 7-14." have been supplemented with a list of citations received. The DVD contains also the book The Thermal Image in Medicine and Biology edited by K.Ammer and E.F.J Ring (1995) plus 3 volumes of an index of "Published Papers on Thermology and Temperature Measurement (Volume 1: 1989 to 2004, Volume 2 2005 to 2006, Volume 3 2007 to 2011). Finally, early thermological publications of the Austrian Society are included (Proceedings of the First Thermological Symposium of the Austrian Society of Thermology: Thermographie, evozierte Potentiale edited by O.Rathkolb and K.Ammer, Proceedings of the Second Thermological Symposium of the Austrian Society of Thermology: Kontaktthermometrie und Thermographie edited by K.Ammer and O.Rathkolb, Thermo graphie 90 - Eine computergestützte Literatursuche by K.Ammer).

A simple navigation system, that guides the reader through the content of each pdf-document, is included and its function will be demonstrated at the meeting.

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REVIEW OF MULTISPECTRAL THERMOGRAPHY AND ITS APPLICATIONS IN BIOMEDICINE

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There are many reasons of using multispectral thermovision systems. First of all, the division of the total spectral range into two shorter windows corresponds to the atmosphere transmissivity which is different for different spectrum ranges. According to this fact, thermographic cameras can work either in MWIR (Mid-Wavelength Infra Red) or LWIR (Long-Wavelenght Infra-Red) ranges [1]. The atmosphere transmissivity depends on the distance of the camera and the object, as well as the relative air humidity. The most important is that it strongly varies with the radiation wavelengths. For this reason multispectral infrared cameras are often used in long range imaging systems. In addition, presence of some toxic and explosive gases affects the atmosphere transmissivity, what results in the ability of gas detection and the concentration measurement [2]. Secondly, the value of one of the most important parameter in thermovision measurements, the object emissivity depends on the wavelength as well. That fact makes possible not only the detection of objects in the observation applications but also emissivity correction for accurate measurements in the more advanced systems. Moreover, referring to Planck's curves, the maximum value of monochromatic power density radiated from the body surface depends on both the object temperature and the wavelength.

The implementation of multispectral thermographic system can be done in several modes. The simplest one is to use the minimum two cameras for different electromagnetic wavelength ranges. The acquired data is processed and combined together for better imaging and interpretation. More sophisticated systems measure radiation power for different wavelength on the detector level. These types of cameras use detectors cooled down to 50-70 K. There are different approaches in building such multiband cameras. It can be done by using indium antimonite interlace detectors, where e.g. odd and even lines measure MWIR and LWIR radiation power, respectively. Another approach uses Quantum Well Infrared Photodetectors. QWIP detectors are based on forming the quantum well using multilayer nanoscale structures. By varying the thickness of given layers one can adjust the absorption characteristics. Some QWIPs are made in form of a stacked structure where every pixel of FPA (Focal Plane Array) contains two detectors. Another group of multispectral systems are ones based on modified MWIR or LWIR cooled cameras. First approach uses spinning filter wheel in front of the detector. Its movement is synchronized with the acquisition and frame rate. The filter wheel consists of a few IR band-pass filters. It allows to get thermograms for subbands of MWIR or LWIR range. Second solution known under the name of hyperspectral camera, uses the diffraction grids or interference filters in order to "select" desirable wavelength and project it onto the detector.

Higher capabilities of multispectral thermal system causes the interest of their use in the medical applications. The IR systems consisting of MWIR and LWIR cameras for breast screening have been already reported [3,4]. The efforts are also being made to use NIR (Near Infra Red) spectrum (wavelength at ~ m) for diagnostic purposes. A NIR tomograph is now using for breast cancer screening [5]. It operates with NIR LEDs which generate the IR harmless radiation to be propagated in the breast. The scattered and the reflected light is measured using tens of sensitive small detectors in order to evaluate the total hemoglobin and in consequence the oxygen saturation of blood vessels [5].

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ESOPHAGUS MEASURED CENTRAL TEMPERATURE COMPARED WITH INFRARED CAMERA TEMPERATURE IN PATIENT UNDER GENERAL ANESTHESIA.

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Patients under general anesthesia are endangered with cooling. Thermal regulation center is in hypothalamus, all anesthetics disturb its function and move thermal regulation point. When gradient between central temperature and skin of the forearm temperature is greater than 4°C, usually peripheral vases contract. Anesthetic drugs move that value to higher level. Without anti heat loosing treatment all patients undergoing general anesthesia are endangered with cooling. Laminar flow devices speed up this process noticeably.

Post surgery cooling implicates negatively patients comfort, it also worsens patients pain killer drugs reactions and improves oxygen patients need, and in effect cooling increases peri-operative respiratory risk and perioperative risk at all. Concerning mostly elder patients under longer surgical procedures.

Human without his clothes in environment temperature lower than thermal comfort temperature, cools down quickly for first 15 min, afterward slowly for next 45 min, reaching balance with environment temperature. Patient under general anesthesia may reach balance with environment temperature even later. During all major surgery procedures temperature should be monitored. From many various temperature monitoring methods central temperature measure achieved with esophageal probe is the most preferable and reliable.

Installing an esophageal probe can be sometimes technically difficult and despite necessity of temperature monitoring avoided while general anesthesia. Moreover it is traumatic for conscious patient and not possible to use during procedures with usage of regional anesthesia techniques. Infrared camera temperature monitoring can be interesting alternative for monitoring temperature while general anesthesia. Especially those internal corners of skin surrounding eyes are supported with branches of ophthalmic artery and this region temperature should respond to central temperature measure.

It takes much effort to prevent patient cooling during general anesthesia. In prevention of cooling during anesthesia all patients under anesthesia for general surgery receive warm i.v. fluids. Anesthesiology and Intensive Care Clinic of Military Institute of Warsaw toked measures to limit cooling with special mattress allowing partly heating up operating table under lying patient. Its efficiency is not known.

This study was designed to exam if central temperature can be monitored in noninvasive way during general anesthesia with usage of infrared camera while examining efficiency of heat up mattresses.

After obtaining consent for participation on study patients over 50 years old, under 30 BMI, planned to general anesthesia for major surgical procedures with predicted lasting time over 2 hours were qualified. Every 15 min infrared camera photo was performed pointing nose base from around 0,5 distance, beginning just before intubation. Room's temperature (laminar flow device set), temperature around patients head, central temperature measure from esophageal probe and mattress temperature were registered. Patients were divided for two groups of patients, first without additional warming during general anesthesia, and latter warmed additionally with warming mattress set to 39°C.

We have managed to include 21 patients witch were randomized in to two groups. First group (n=11) were patients without additional warming up with mattress and second group (n=10) additionally warmed up to 39ºC. Groups statistically did not differ within age, weight, height and BMI (body mass index), and thus second group had slightly lower median BMI (26, 7 vs. 23).

Esophagus measured central temperature for both groups showed similar trend of cooling patient till 1 hour 45 minutes after intubation, respectively from 36,7ºC to 35,9ºC in the first group and from 36,4ºC to 35,7ºC in the second group. It changed afterwards, while patients which were not additionally warmed up continued to cool down to 35,8ºC 2 hours and 15 minutes after intubation, the latter group stared to recapture heat and warmed

up to 36,4ºC 2 hours and 15 minutes after intubation. Data shown in diagram 1 (First group central temperature Dt gr1, and second Dt gr2).

Infrared photos were analyzed in two different measure areas. First was an average from two infrared temperature count marked from medial skin of aye corners. This count shows similar trend like in central temperature count, from 35,9ºC after intubation to 35,2ºC 1 hour 45 minutes after and 34,6ºC 2 hours 15 minutes after intubation in first group (It gr1 in diagram 1), and respectively 35,5ºC, 35ºC and 35,6º in the second group (It gr2 in diagram 1). The latter measure was taken from nasal basement and it showed essentially lower temperatures. 34,5ºC, 33,8ºC and 32,9ºC respectively in the first group (Nit gr1 in diagram 1) and 33,3ºC, 33,7ºC and 34,6ºC in group 2 (Nit gr2 in diagram 1). Central temperature cannot be measured after extubation due to previous removing of esophageal temperature probe. Infrared aye corners skin median temperature after awakening and extubation of patient shows sudden drop of temperature to averagely 33,2ºC in group 1 and 34,3ºC in group 2. Nasal basis infrared measure after extubation show even deeper temperature drop to averagely 32,1ºC in first group and 32,7ºC in the latter.

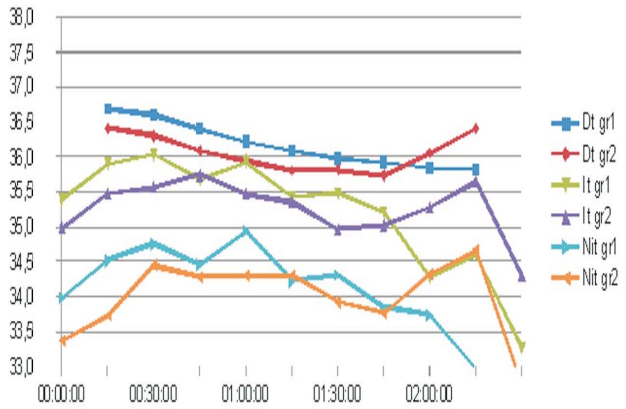

Diagram 1

Onset results of group 1 measurements are higher than one from group 2. It can be related with slightly lower BMI in this group. However, trend for quicker cooling in unwarmed group with tendency of rewarming after 1 hour 45 minutes of anesthesia in the second group, shows that this method of cooling prevention can be useful.

Similar trend in medial aye corners skin infrared for both groups measurements can point out usefulness of this method in attempts of finding noninvasive method of central temperature monitoring during general anesthesia. Lack of identical measurements between esophagus measurement and infrared measurements is probably related with imperfection of method and influence of breathing cycle on measurements count. Larger exam group should partly eliminate this problem. Further study is necessary on that issue.

Nasal basis infrared temperature count cannot be used to deep temperature monitoring during general anesthesia due to large difference in temperature measurements compared with central temperature count.

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THERMOGRAPHIC EVALUATIOAnestezjologia" 2005, 719-721N OF MIGRAINE

Juliana Badaro[1], Monica Lima[1], Joaci Araújo[1], Adolfo Marcondes[1], Mark Brioschi[1], Manoel Jacobsen Teixeira[1], Ricardo Vardasca[2,3]

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Headache is a very common symptom in clinical practice, but unber valued in skills due to lack of objective documentation. Migraine is a type of primary headache caused by a cranial inherited neurovascular dysfunction. Characterized by recurrent attacks of headache hemicranial and pulsatile with or without aura, nausea, vomiting, photophobia, phonophobia and fatigue sensation. In a crisis situation all stages are not always necessary. Can lead to decreased productivity, loss of quality of life of patients and if not treated promptly it can result on amplification of pain, abnormal brain neuroplasticity and chronicity of pain. Migraine decreases the blood flow of the internal carotid artery (ICA) and consequently cause ischemia on the occipital spot, which explains the scotomas. The image obtained by the infrared thermal thermography through a functional examination can detect temperature changes in skin territory corresponding to cerebral circulation extra ICA. This change which causes temperature decrease in frontal supraorbital region is called "cold patch" (hyporadiation) and aids in the differential diagnosis of other causes of facial and skull pains in clinical and forensic. Thermography is an excellent marker for assessing migraine and guidance regarding the etiology and forensic documentation.

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THERMAL TRANSIENT THERMOGRAPHY FOR HUMAN SKIN MODELING AND SCREENING

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The aim of the research was to verify whether the power of radiation used in the provocation thermal test has any influence on the skin reaction, especially on the thermal time constant corresponding to the rate of heat removal by blood flow and thermoregulation. The temperature on the hand palm has been measured using the thermovision camera after thermal excitation

(provocation). The halogen lamp with the radiation power density in the range of P = 500W/m2 - 3000W/m2 was used in the experiment as an external infrared radiation source. After the hundreds of image recorded, the temperature evolution vs time was plotted (Fig. 1).

All the measurement temperature curves have been approxi-

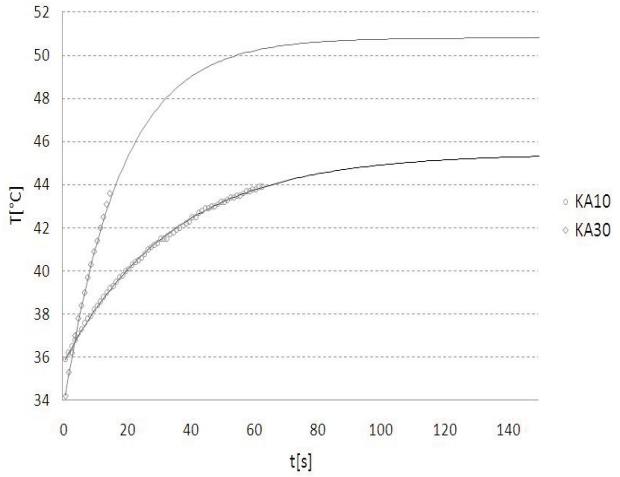

Figure 1
Example of single time constant approximation of the measured temperature rise during the heating

mated by the exponential functions and two parameters were taken into consideration - amplitude and the thermal time constant. A simple one layer thermal model was created in order to extract thermal parameters of the skin [3]. The thermal model includes the thermoregulation effect by blood flow and convection by the air (Fig. 2).

Using the temperature rise and time constant from experimental

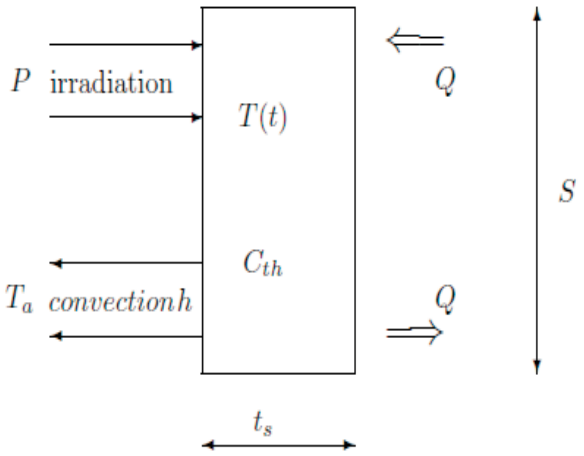

Figure 2
Thermal model of the skin with thermoregulation,
S – area of the skin considered in the model, t_s – skin thickness,
h – convection heat transfer coefficient, T_a – ambient temperature,
C_{th} – thermal capacitance of the skin

data, the thermal parameters from the model was extracted. The results correspond to the values getting from literature [3]. The results of the modeling confirmed that the perfusion has a crucial role in thermoregulation effect in the skin [1-3]. The simulation together with the experimental data proved that the cooling the skin by the blood flow was about five times higher than by the natural convection [3]. In addition, it was found out that thermal model of the skin is non-linear (temperature rise is not proportional to the power) and that the temperature of the skin depends on the power of infrared source. This fact is very important, and has to be taken into account in every thermal provocation test applied especially in the medicine.

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THERMOGRAPHY OFThese results provide additional support for the continued study on the equine thermography. THE SKIN AS A METHOD OF INCREASING LOCAL INJECTION SAFETY

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INTRODUCTION: For a long time the process of introduction of drugs in the organism of patients not controlled by the reaction of tissues, interacting with drugs as their absorption and penetration of the blood, because there were no methods of safe and informative visualization methods [1,2]. In connection with this remained unknown features of the local drug interactions with various tissues and causes of their injuries caused by the introduction of certain medicines into the organism. Moreover, these complications associated with the violation of the technologies of introduction of drugs, so the perpetrators of complications were medical workers, violated the technology of introduction of drugs [3]. However, in recent years, there is evidence that the cause local damage can be themselves drugs, because modern standards of their quality admit that they have de- naturalizing action [4,5,6].

In these circumstances, the identification of universal indicators of the local pharmaceutical aggressiveness of drugs is an urgent task.

METHODS: A retrospective analysis of the areas of local application of solid and liquid medicines in 1000 patients in the hospital and out-patient treatment during the 2000 - 2012. The study of the condition of the places of injections in the visual, ultrasonic and infrared study of 100 patients are female and have 100 patients of male sex during their hospital treatment in the various branches of several city hospitals of the city of Izhevsk in 2012. The study was approved by the Ethics committee at Izhevsk State Medical Academy and complied with the Declaration of Helsinki. All patients gave informed consent.

Experiments were carried out on 20 keepers of pigs, which have carried out monitoring of a condition of the tissues of the oral cavity and congestion after local application of tablets and eye drops (respectively) and the condition of the skin and subcutaneous fat after subcutaneous injection of solutions 40 drugs before and after reconstitution with water.

Clinical and experimental studies of the pharmaceutical aggressiveness of medicines carried out with the account of factories-manufacturers, rooms series, pharmaceutical formulations, the values of the controlled physico-chemical quality indicators and some other characteristics.

Dynamics of a tissue with the introduction of these drugs was estimated in different years on the eye, with the help of the ultrasonic brand Aloka SSD-900 and through determination of the Dynamics of temperature and infrared radiation of bodies by ThermoTracer TH9100XX (NEC, USA). The obtained data were processed using software Thermography Explorer and Image Processor.

RESULTS: Our results indicate that every patient in the hospital and out-patient treatment is being daily from 1 to 12 oral tableted medicines and from 1 to 25 of hypodermic, intramuscular and intravenous injection of solutions of medicines. Therefore, today the absolute majority of the drug is introduced into the organism of patients through intravenous injection.

However, the medical records do not contain any information about the state of tissues on the introduction of the pills, eye drops and solutions for injections. Including the absence of information about the appearance of inflammation, bruises, hematomas and abscesses in the field of local action of eye drops, tablets and solutions for injections. At the same time, the observation of the state of organs of vision in adult patients with conjunctivitis and the babies with the introduction of these solution 25% sodium sulfacyl, conducted by the inspection of the skin of the buttocks and the elbow of the basins in pregnant women after multiple intramuscular and intravenous injections of plasma substitutional solutions and hemostatic products, as well as conducted by the observation of the state of mucous membranes of the mouth, gums and cheeks for women in the resorption of tablets acetylsalicylic acid, showed the presence of local inflammation at all 100% of patients.

Then we conducted an analysis of the legal list of controlled indicators of the quality of solutions for injection and the ranges of their possible values. It turned out that dispensatory requirements do not regulate the production of solutions for injection with a pH of 7.4, with an indicator of osmotic activity 280 mOsmol/l of water, as well as with the lack of local inflammatory (annoying) and denaturation (caustic) of action on the tissues in the ways the introduction of drugs. Therefore, solutions for injections that are considered today quality, can provide a cauterizing an (denaturation of action) action.

After this we decided to use the tissue temperature in the role of indicator urgent rapid assessment of their reaction to drugs. As the most secure, accurate, urgent and documented way of measuring the surface temperature of a thermal imager, to solve this problem we used a monitoring with the help of thermal imager of heat emission. Our results show that urgent monitoring with the help of thermal imager the local temperature of the mucous membranes of the lips when resorption of tablets acetylsalicylic acid, ketorol, or ascorbic acid, as well as the mucous membranes of the conjunctiva in instillation in the eye of the eye drops containing a solution of 25% sodium sulfacyl, or the skin of the buttocks when the intramuscular injection and/or the skin of the antecubital fossa with injections in cubital Vienna 5 ml solution 25% magnesium sulfate really allows you to receive early information on the fate of tissue on the introduction of drugs. Moreover, we have obtained data testify to the fact, that for the forecast of the local drug interactions is sufficient to determine the dynamics of local tissue temperature for 10 minutes after the start of their interaction with the drugs.

As an example, the image of the person of the newborn on the screen thermal imager at the time of and after 2 minutes after the introduction of drops of solution 25% sodium sulfacyl at a temperature of +24 C in the cavity of the conjunctiva of the left eye (Figure 1).

It is established that the drugs have annoying and/or cauterizing an action, cause, and medication, deprived of pharmaceutical aggression, not a cause in this period of time the local hyperthermia in places of local interactions. Therefore, the registration of the dynamics of the local temperature tissue in places of local interactions of medicines, implemented for the first 10 minutes after injection of medications, can claim the role of a universal indicator of Express-diagnostics of the pharmaceutical tissue damage to the introduction of drugs.

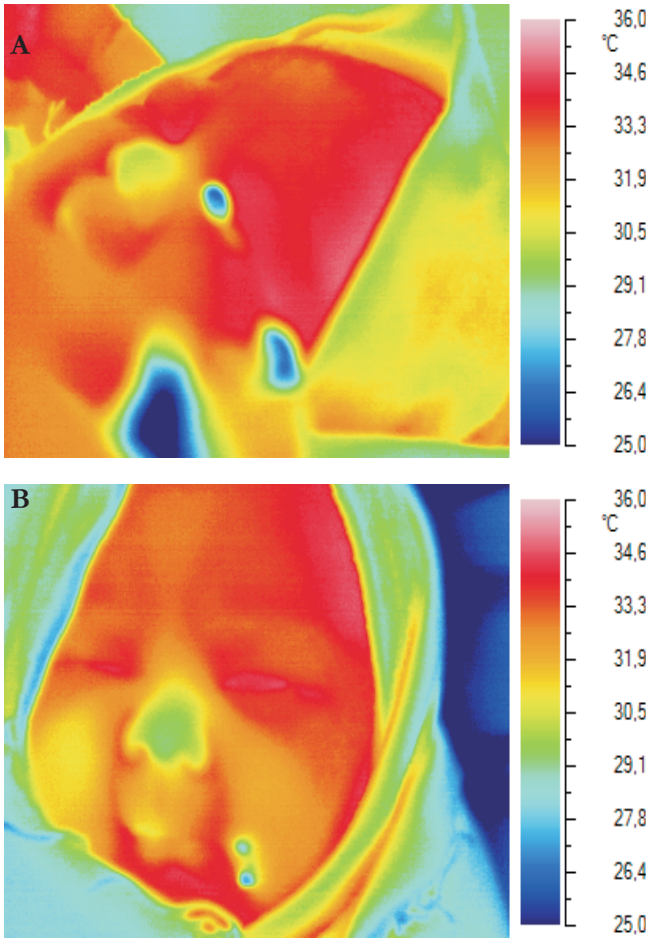

Figure 1.
Image of the face of a newborn (15.02.12) on the thermal imager at the time of the introduction of (A) and after 2 minutes (B) after the introduction of drops of solution 25% sodium sulfacyl at a temperature of +24° C in the cavity of the conjunctiva of the left eye

CONCLUSION: Changing the heat radiation of tissue during their interaction with the drugs proposed to consider as a universal criterion of the local drug safety when administered to the mother, her fetus and newborn. It is shown that the temperature of the tissue at the site of safe drug may decrease for a short time, but then normalized. Medicine, with irritant or cauterizing action, cause long-lasting local hyperthermia.

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EFFECT OF DRUGS TEMPERATURE ON INFRARED SPECTRUM OF HUMAN TISSUE

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Introduction: It is known that a change in the local or general temperature of the human body can cause biological effects, which are currently not achievable in clinical practice in any other way, even with the use of pharmacological agents. In addition, the pharmacokinetic and pharmacodynamic effects of all medicines were temperature dependent (1). Occurrence in clinical practice Digital Infrared Thermal Imaging (DITI) allowed to expand understanding of the interaction of drugs and organs (tissues) of the target based on their temperature (2,3). It is shown that the artificial lowering or raising the temperature of drugs compared to the temperature of the patient gives them thermocontrasting properties and provides visualization at the thermal imaging monitoring of the "invisible" on the surface of the body structures, such as saphenous veins. (4). Identified thermo-pharmacological effects of drugs allowed to develop a safe and non-invasive way to visualize subcutaneous veins in the infrared spectrum of radiation with a thermal (5). As "thermocontrasting" substance recommended to use warm and cold solution of drug or blood (6,7).

METHODS: Observations were carried out in 70 patients of anesthesiology and intensive care department of clinical hospital No 9 (Izhevsk, Russia) in 2008-2009. Dynamics of temperature and infrared radiation of patients' bodies in intravenous drug injection investigated by ThermoTracer TH9100XX (NEC, USA). The obtained data were processed using software Thermography Explorer and Image Processor The study was approved by the Ethics committee at Izhevsk State Medical Academy and complied with the Declaration of Helsinki. All patients gave informed consent.

RESULTS: In the course of the research revealed that health workers are ignored and not recorded temperature readings of drugs solutions and injection sites. Determined that the temperatures of solutions for intravenous use, correspond to the temperature of storage +24,3 ± 1,2 ° C (n = 70). At the same time, the temperatures of patients skin in the place of intravenous injections were +35,1 ± 1,4 ° C (n = 70). Digital Infrared Thermal Imaging of the patients' bodies at the range +25,0 - +36,0 ° C revealed that "cold" solutions of drugs are depicted in blue, and the skin in the place of intravenous injections of red-orange-yellow. By intravenous administration of "cold" solution is reversible cooling veins and change their spectrum of infrared radiation over its surface to blue. The possibility of infrared imaging of subcutaneous veins in giving them a cold drug solution prompted us practical significance of this relationship as a possible alternative to the X-ray diagnosis of venous. Study confirmed this assumption - namely, the ability to identify saphenous veins with a Digital Infrared Thermal Imaging without any exposure of the patient and without the introduction of contrast media (Figure 1).

CONCLUSION: The difference (contrast) solution temperature, inside the saphenous veins, and tissues surrounding the veins, provides high-quality and secure visualization of veins in the Digital Infrared Thermal Imaging.

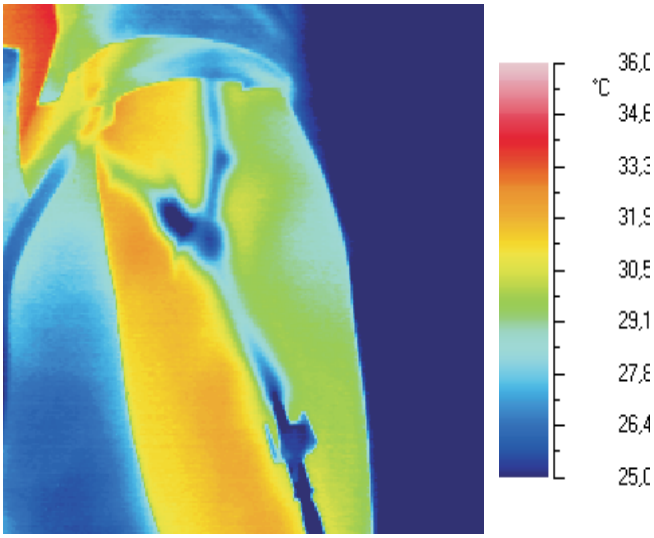

Figure 1
Infrared image of the left forearm of patient T, at age 34, recorded 1 minute after intravenous injection of a 0.9% solution of sodium chloride at room temperature at a rate of 120 drops per minute.

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COMPARISON CLINICAL, ULTRASOUND AND THERMOGRAPHY POINTS IN IDENTIFYING MYOFASCIAL TRIGGERS IN PATIENTS WITH FIBROMYALGIA

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The myofascial pain syndrome and fibromyalgia syndrome are common painful musculoskeletal conditions that often coexist in the same patient. OBJECTIVE: This study aimed to evaluate the parameters of sensitivity (S) and specificity (E) Thermography and Clinical palpation in the diagnosis of myofascial trigger points in patients with fibromyalgia syndrome. METHODS: Sensitivity (S) is the probability that a test result is positive when the disease and specificity (E) is likely to give a test negative in the absence of disease. We examined 40 patients with trigger points

in myofascial pain syndrome associated with fibromyalgia by three different methods: clinical palpation, thermography and ultrasound as reference. For thermography, one of the criteria for positive diagnosis was a difference of 1° C from the contralateral region.

RESULTS: Thermography showed S = E = 79.31% and 50.00%. Already presented clinical palpation S = 65.52%, E = 18.18% when ultrasound was taken as reference. Joining thermography with palpation sensitivity was 93.1%.

CONCLUSION: Clinical assessment when integrated thermography showed higher diagnostic sensitivity in screening trigger points in patients with fibromyalgia, but not replace ultrasound confirmation. However ultrasound does not identify trigger points alone without guidance of palpation and thermography.

USAGE OF THERMOVISION IN EVALUATION OF THE INFLUENCE OF SPORTS MASSAGE ON SELECTED BIOMECHANICAL AND PHYSIOLOGICAL PARAMETERS OF LOWER LIMBS

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INTRODUCTION. Dynamic development of sport make the necessity to look for new indicators to achieve information of effectiveness of training and sport contests.

AIM. The aim of the study was to establish an of relationship between temperature of muscle quadriceps femoris and strength, power and, bioelectric potential.

MATERIAL AND METHODS. 23 women (aged 19-23) participated of the research. Camera Flir A325 was used for thermographic picture. Power was measured by OptoJump Next system while maximal torque was measured on the dynamometric Sumer UPR-02 arm-chair. Measurement of the surface electromyography was done with the utilization of the telemetric system Trigno 16ch . All tests were used twice - before and after the massage of muscles quadriceps femoris. Classic, sports, warm-up massage were applied.

RESULTS. After the massage temperature of massaged muscles (quadriceps femoris) significantly increased ($p<0,05$). We observed also ipsilateral effect of massage because - temperature of unmassaged shank muscles and the back of the thigh also rised. There were not significant differences in power level measured by counter movement jump ($p>0,05$).

CONCLUSION. Classic, sports massage has influence on temperature of muscles, but it is not enough to prepare to physical activity without warm-up activity.

RELATIONS BETWEEN THERMAL PORTRAIT AND AEROBIC CAPACITY - EVALUATION OF THERMOREGULATION EFFICIENCY THROUGHOUT THERMOVISION

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INTRODUCTION. As has been proven, thermal portrait can be connected both with VO2max as well as aerobic and anaerobic thresholds. One of reasons of such dependence is strong correlation between physical fitness and thermoregulation mechanisms which allow to give back excess heat.

AIM. Establishing relations between thermal portrait and physical fitness level measured by maximal oxygen consumption (VO2max).

MATERIAL AND METHODS. Totally 21 subjects were conducted in the study, including 13 rowers an 8 untrained males. For maximal oxygen consumption we used treadmill and incremental test protocol to the volitional exhaustion. Starting speed was set 8 km/h and after each 3 min was increased by 2 km/h. To VO2max analysis breath-by-breath MetaLyzer II system was used. Thermovison scanning was performer with using Flir A325 thermocam. Examined area of body was divided for 11 parts.

RESULTS. Average values Vo2max for examined rowers were slightly higher than 55 ml/kg/min. In untrained subgroup VO2max values were significantly lower ($p=0.000$) and was 43 ml/kg/min. No significant correlations between BMI and %FAT in comparison to VO2max and temperature changes after test effort were found. In whole examined group, statistically essential relation between VO2max level and lowering surface temperature of front side of trunk were found ($p= -0.44$; $p<0.05$). For the group with higher Vo2max - lower surface temperature of front forearm and back of thigh were strongly correlated with maximal oxygen consumption ($r= -0.93$).

CONCLUSIONS. Relations between maximal oxygen con sumption and thermal reaction on progressive effort to volitional exhaustion found in the research suggests, that thermography can be effective method of indirect evaluation of aerobic capacity. Better physical fitness is connected with efficient thermo- regulation mechanisms, responsible for giving back excess heat. This effect was spotted in better trained males.

THE EFFECTIVENESS OF THERMOGRAPHIC ANALYSIS IN EQUINE ORTHOPEDICS

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One of the main advantages of equine thermography is the detection of subclinical inflammation. The present study was undertaken to determine a specific threshold value of temperature change indicative of subclinical inflammation of the lower parts of the horse's limb.

The study involved monitoring 20 racehorses over a period of 10 months. Temperature measurements of IIIed metacarpal region were taken every 3 weeks allowing the average temperature differences to be ascertained between the same areas of forelimbs from the dorsal and palmar aspects in each session. Additionally, ultrasonographic and radiographic standard examinations of lower part of forelimbs were conducted to diagnose any pathological conditions of lower forelimbs. To determine the threshold value of temperature difference the Receiver Operating Characteristic (ROC) curve method was used, based on thermo- graphic examinations of the same measured area in 20 horses.

The threshold value of temperature difference indicative of subclinical inflammation was found to be 1.25 °C. In conclusion, thermography can be used as a quick and practical diagnostic tool of subclinical inflammation. These results provide additional support for the continued study on the equine thermo- graphy.

ERRORS AND ARTEFACTS IN INFRARED IMAGING

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Most medical imaging procedures share the common problems of errors and artefacts that can disguise or confuse the clinician. The sources of error begin with the patient, the environment used for imaging, the camera system, the image itself and the image analysis. In thermography which is an image procedure for body surface temperature, the environment can be especially important. In high ambient temperatures the human begins to sweat, as part of the heat balance process, and at cold temperatures shivering becomes a form of thermogenesis. Both of these mechanisms will adversely affect the themogram. There is now good evidence that careful positioning of the patient is important especially to improve repeatability, anf the method by which regions of interest are selected for measurement must be made using protocols that improve repeatability. Even with these provisos, the camera system may be subject to errors, due to faulty calibration, drifting and loss of resolution if too large an area of the body is being imaged.These important issues have been published and taught for the last decade or longer. However they are so important to good practice that it is useful to examine how these issues are being resolved with improved technology, or not, and how constant observations in clinical practice will benefit the long term reliability of thermal imaging in medicine.

DECREASE OF THE TEMPERATURE OF THE HEAD OF THE FETUS DURING BIRTH AS A SYMPTOM OF HYPOXIA

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INTRODUCTION: Despite the fact that fetuses and newborns continue to die during pregnancy and physiological delivery of sudden intrauterine hypoxia existing standards do not include delivery methods for monitoring and immediate detection of this pathology. Therefore, hypoxic damage of the cerebral cortex of the fetus is still not perceived to laboring women and "not visible" for obstetricians. Proposed in 2010 a radical removal of intrauterine hypoxia with respiratory masks to the fetus (intrauterine aqualung) and gas exchange in a way to ensure his body by artificial breathing (ventilation fetal lung breathing gas) inside the uterus was not supported by obstetricians and does not apply in practice [1,2].

In these circumstances, in 2012, we have developed a method of express-diagnostics of hypoxic damage of the cerebral cortex of the fetus and obstetrical benefits in vain attempts with a thermal imager [3,4]. The method is based on the following pattern revealed by us: hypoxia and ischemia tissue reduce the intensity of radiant heat.

METHODS: Thermography conducted in a maternity hospital in the physiological delivery in 35 pregnant women admitted for urgent delivery The control group included 20 women, with the re-birth, having healthy children, born in time. In addition, the criteria for selection of the control group pregnant women is high stability of their fruit to intrauterine hypoxia, confirmed in 30 - 32 weeks of pregnancy results Gauskneht functional test (more than 30 seconds). Another group of women studied consisted of 15 pregnant women who have previously had a successful physiological birth with the birth of live fetuses in the project schedule. Additional selection criterion in this group was the low stability of births of their fruit to intrauterine hypoxia, confirmed in 30 - 32 weeks of pregnancy test results Gauskneht (less than 10 seconds). Other than that, there was a pregnant woman entwined cord around the neck and chest of the fetus.

Infrared thermometry was performed using thermal imager ThermoTracer TH9100XX (NEC, USA) in the temperature range +26 - +36° C. The temperature of the air in the delivery room is in the range +24 - +26° C. The obtained data were processed using software Thermography Explorer and Image Processor.

RESULTS:Our results showed that monitoring Thermal imaging in the infrared spectrum of the radiation provides the definition temperature of the parietal part of the head of the fetus throughout the second period of labor and after the birth of the baby until the umbilical cord cut off and wraps baby in a diaper.The range of the individual indicators of the local temperature in the skin of the parietal part of scalp of live fetuses in the process of birth and the newborn immediately after birth in our study was between +31,6 °C and +36,1 °C. Found that in normal pregnancy and normal physiological delivery image of the head of living fetuses is depicted on our Thermal imager predominantly yellow-orange-red colors.

In addition, the fetuses who had the high values of prenatal test Gauskneht for resistant for hipoxia , during the childbirth had a stable pattern of heat radiation. In addition, the fetuses who had the high values of prenatal test Gauskneht (defining the resistant for hypoxia), during the childbirth had a stable pattern of heat radiation. The fetuses who suffered of prenatal hypoxia and having meconium in amniotic fluid, in childbirth demonstrated periods with reduction of thermal radiation. Moreover, in the norm on the surface of the parietal part of the head of the fetus can be detected identified portion of the local hyperthermia, in which temperature can be 0.5 - 4 ° C above the temperature of the surface of the head. This plot has an elongated shape and is located in the projection of not fused bones the Central seam of the cranium. But the other five fetuses in second period of physiological childbirth demonstrated short periods of reduced temperature of scalp of the projection of not fused bones the Central seam of the cranium. (figure 1). The duration of these periods ranged from 30 to 120 seconds.

We carried out an analysis of the circumstances surrounding the emergence of local hypothermia. The results showed that the immobility of fetuses in the period between attempts lead to the conservation and the progress of the local hypothermia fetal presenting part of the head, and the promotion of the baby on ancestral ways the efforts of the mother has restored radiation is already in 2-3 seconds from 5 fetuses of a monitoring group.

Thus, these results suggest that the dynamics of the temperature of the fetal scalp in the projection of not fused bones the Central seam of the cranium allows to evaluate the provision of oxygen cortex of brain of the fetus during labor , because the lack of oxygen leads to temperature reduction in the process of oxidative metabolism in the mitochondria of the brain, which promotes cooling the scalp fetus during labor in the presence of air at room temperature.

In this regard, the absence of periods setback temperature scalp during in moving fetus through the birth canal indicates the possibility of a healthy child in the process of physiological birth, and the emergence of local hypothermia in the projection of not fused bones the Central seam of the cranium indicates the beginning hypoxic and ischemic damage of cerebral cortex of the fetus and requires immediate hyper-oxygenation blood of the fetus.

In the absence of prenatal scuba gear to rescue the fetus immediately give his body continued progress with the initiation of the extraordinary attempts. This is necessary for the early birth and early lung ventilation air, or to reduce the period and/ or depth of hypoxia and ischemia of the brain, as their cause may be the "wrong" location of the fetus in the birth canal. That's why if you can not birth the fetus requires immediate move it forward through the birth canal until the restoration of the skin temperature of the slit of his skull.

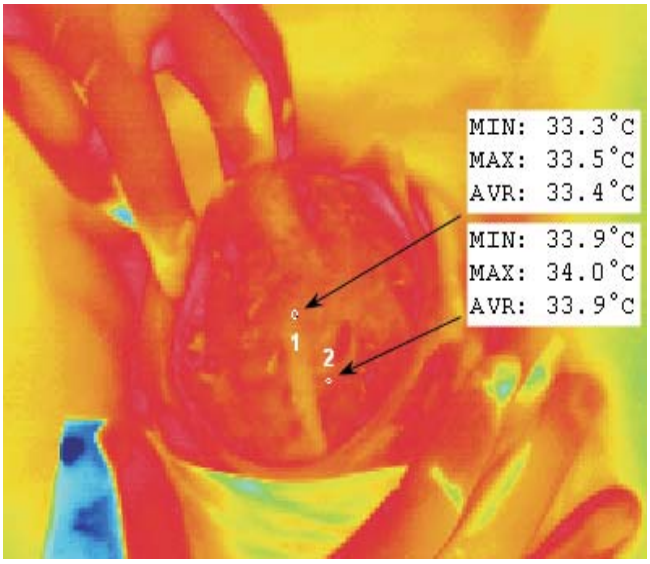

Figure. 1.
Image of the surface of the head of the fetus at its exit from the birth cana.l in S mothers after 30 attempts and after the stop of the fetus in the birth canal in the infrared spectrum of the radiation diapazone indicating the values of the local temperature of the skin over the center seam (1) and over the bones of the skull (2)

The experience of clinical application of the method allows to conclude that it is easy accurately reproduce in the conditions of any of the maternity hospital.

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ERRORS AND ARTEFACTS IN INFRARED IMAGING

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Most medical imaging procedures share the common problems of errors and artefacts that can disguise or confuse the clinician. The sources of error begin with the patient, the environment used for imaging, the camera system, the image itself and the image analysis. In thermography which is an image procedure for body surface temperature, the environment can be especially important. In high ambient temperatures the human begins to sweat, as part of the heat balance process, and at cold temperatures shivering becomes a form of thermogenesis. Both of these mechanisms will adversely affect the themogram. There is now good evidence that careful positioning of the patient is important especially to improve repeatability, anf the method by which regions of interest are selected for measurement must be made using protocols that improve repeatability. Even with these provisos, the camera system may be subject to errors, due to faulty calibration, drifting and loss of resolution if too large an area of the body is being imaged.These important issues have been published and taught for the last decade or longer. However they are so important to good practice that it is useful to examine how these issues are being resolved with improved technology, or not, and how constant observations in clinical practice will benefit the long term reliability of thermal imaging in medicine.

DEVELOPING A THERMAL IMAGING PROTOCOL FOR USE IN EMERGENCY CARE ENVIRONMENT

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Thermal imaging is a relatively new investigative tool in the field of medicine, with potential to play a crucial role in the monitoring of existing disease as well as the diagnosis of new. To date, a few protocols have been devised introducing a standardised way to use this technology within medicine, as seen by work carried out by Professor Francis Ring and Professor Kurt Ammer at the University of Glamorgan. The aim of this study is to further this work and develop a standardised protocol which can be used to consider whether a role for thermal imaging exists within an emergency care environment.

20 volunteers were invited to a laboratory at the Leicester Royal Infirmary. The laboratory was a constant to allow standardises environmental conditions. The volunteers were asked to change into a hospital gown, to allow exposure of the upper limb, and begin the start of a 15 minute acclimatisation period. Both arms were then imaged, in 3 different positions, from both the anterior and posterior aspect.

We aim to ascertain whether the position of the arm impacts on the thermal data recorded. This information would provide the foundation for the protocol to be used when applying the thermal imager within the Emergency Department (ED). Currently we do not have information with regards to whether the dominant or non-dominant arm provides significantly different data or whether imaging the anterior compared to the posterior aspect of the arm will give conflicting data and therefore we will aim to answer these questions within this study.

We will also explore the impact of holding the arm in a fixed position for a short period of time and identify if this is something that may influence how pictures are obtained in the ED Finally we are researching into an alternative method for identifying regions of interest along the upper limb. We will determine if there is a role for physical markers at anatomical landmarks (at the acromio-clavicular joint, across the ante-cubital fossa and the wrist) to identify new regions of interest which correspond to underlying vascular anatomy

THE EFFECT OF WHOLE-BODY VIBRATION ON THERMAL SYMMETRY OF THE LOWER LEGS IN HEALTHY SUBJECTS

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INTRODUCTION: Vibration exercise has become an alternate modality for proprioceptive, strength and balance training. It is practiced mostly while standing in vibration platforms and due

to the widespread of vibrating plates distribution, its popularity is increasing. Few studies have addressed the effect of this exercise modality using skin temperature as an outcome measure and fewer have studied the effect of whole-body vibration on thermal symmetry. Thermal symmetry can be useful in the process of differential diagnose in a certain clinical context. The aim of this study is to evaluate the impact of acute exposure to vibration exercise on thermal symmetry of the lower legs in healthy subjects.

METHODS: Skin temperature of thirty six healthy and non trained male and female subjects (randomly distributed to the experimental and control group) was recorded using thermography, before and after the exposure to vibration exercise or control setting. A calibrated thermographic camera (FLIR A325) was used to record skin temperature. All subjects were instructed to undress, remain still in the examination room for 15 minutes in order to achieve thermal stabilization. The room was stabilized at 22º Celsius, with absence of air flow and humidity was less than 50%. Thermograms were obtained from the views: Leg, right (lateral view); Leg left (lateral view); Leg, right (medial view); Leg left (medial view); Lower legs (anterior view); Lower legs (dorsal view) and Both ankles (anterior view) before and after exposure to vibration. The Power Plate® provided a mechanical stimulation with parameters set at a frequency of 35Hz, high amplitude (5-6mm), resulting in maximum acceleration of 121-145 m/s2, for 5 minutes.

RESULTS: Thermal symmetry was higher in the anterior aspect of the lower leg (0.17±0.13ºC) and lower in the lateral aspect of the ankle (0.27±0.20ºC) and medial aspect of the ankle (0.26± 0.21ºC). The acute bout of exposure to whole-body vibration significantly increased thermal symmetry in both ankles (anterior view) and decreased thermal symmetry in the lateral aspect of the ankle (p?0.05). Significant differences on thermal symmetry before the exposure to the experimental setting between male and female participants were not found.

DISCUSSION: The results suggest that the exposure to an acute bout of vibration exercise (35Hz) has an effect on thermal symmetry of the ankles, though the mechanism underlying these changes will require future studies to be fully understood either in healthy and patient subjects. Caution should be taken by health and exercise professionals before prescribing this exercise modality since future research is still needed to clarify the potential mechanisms influencing microcirculation.

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USEFULNESS OF LINEAR PREDICTIVE CODING COEFFICIENTS FOR THE QUALIFICATION HEALTHY PEOPLE AND PATIENTS WITH SINUSITIS BASED ON FACIAL THERMOGRAMS.

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Standard technique of temperature measurement is simple and cheap but does not allow to determinate human surface temperature distribution, It is necessary to perform an analysis of temperature values distribution for marking of spots with intensified heat on human body surface, which can be observed in states of inflammation (e.g. Paranasal sinusitis). With usage of infrared camera and specialistic software it can be done [1,2,3,4]. Classification of patients to previously defined groups (e.g. healthy and sick) can be performed by converting received data. Method typically used for speech analysis, LPC (linear predictive coding) coefficients were used to analyze received signal [5, 6].

Possibility of patient qualification as paranasal sinusitis sick basing on value of signal received from face thermogram was goal of this exam.

MATERIAL: 93 thermograms of healthy and 70 sick with paranasal sinusitis, recognized in advance with physician's examination, were used to design the method of patients qualification.

METHOD: Pattern for healthy and sick person were appointed as thermogram of mean value of temperature form therm ograms transferred from standard rectangle structure to bipolar structure (a_r, α) where $\alpha = 0°..359°$ and ar = 0.01..1 with a 0.01 step. Ar value responds to proportion of length vector counting from middle of ellipsis to examined point of thermogram in head area up to ellipsis radius length for requested angle α (figure1).

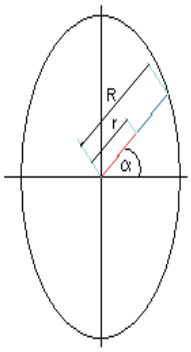

Figure 1:
Transduction from rectangle structure to bipolar elliptic face contour.

Finally value $a_r(\alpha)$ is described with pattern

$a_r(\alpha) = \frac{r(\alpha)}{R(\alpha)}$, where α ==...359

Conversion generates 360 x 100 values of temperature for every thermogram within area of interest. A converted picture for healthy and sick mean was made and medial thermogram was marked.

Pattern basis of healthy and sick were appointed on base of marked thermograms encrypted in the structure $a_r(\alpha)$

Marked LPC covariates were estimated in qualification process. Measure of probability was assessed as length of LPC covariates base from pattern of sick person

$$D_{si} = \sum_{i=1}^{p} \left\| LPC_i^{x} - LPC_i^{si} \right\|$$

and from pattern of healthy person

$$D_{be} = \sum_{i01}^{p} \left\| LPC_i^{x} - LPC_i^{be} \right\|$$

where: p - number of LPC covariates. Qualification process for marked numeric values relayed on establishing values of correlation:

$$Group = \left\{ \begin{array}{ll} Healthy.\ for & D_{be} < D_{si} \\ Sick.\ for & D_{be} \geq D_{si} \end{array} \right\}$$

Next step was to establish minimal amount of covariates allowing qualification of patient to proper group with minimal classification error. Calculation in range from 1 to 30 covariates was performed due to marking proper group in function of number of LPC covariates for every case. In effect every case was qualified to groups:

a)healthy - healthy

b)healthy - sick

c)sick - healthy

d)sick - sick

in dependence from known physicians examination diagnosis and marked, as a result, comparison of LPC covariates. Probability in function of number of LPC covariates was marked for qualified patients in this manner.

DISCUSSION: Values probability analysis shows optimal classification for 14 (n_{LPC})of LPC covariates number. For this number there are no false negative classifications and only 1,1% false positive classifications witch can be verified and excluded by proper clinical examination. Increasing number of LPC covariates does not lead to relevant increasing in classification precision, with large simultaneous increase of data needed to be converted.

CONCLUSION:

1.Application of LPC covariates in signals analysis marked from facial thermograms, allows qualification of patient to proper group healthy or sick.

2.Values of proper qualification probability are dependent on number of covariates and they are acceptable when $n_{LPC} = 14$.

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Table 1.
Probability of proper group qualification, depending on number of LPC covariates function

Number ofLPC covariates	Probability			
	healthy – healthy	healthy – sick	sick – healthy	sick – sick
1	0.6154	0.3846	0.3429	0.6571
2	0.7582	0.2418	0.4714	0.5286
3	0.8462	0.1538	0.3143	0.6857
4	0.9341	0.0659	0.2429	0.7571
5	0.9231	0.0769	0.2000	0.8000
6	0.8901	0.1099	0.1429	0.8571
7	0.9121	0.0879	0.0571	0.9429
8	0.9231	0.0769	0.0286	0.9714
9	0.9231	0.0769	0.0000	1.0000
10	0.9231	0.0769	0.0000	1.0000
11	0.9341	0.0659	0.0286	0.9714
12	0.9341	0.0659	0.0143	0.9857
13	0.9451	0.0549	0.0143	0.9857
14	0.9890	0.0110	0.0000	1.0000
15	0.9890	0.0110	0.0000	1.0000
16	0.9890	0.0110	0.0000	1.0000
17	0.9560	0.0440	0.0000	1.0000
18	0.9670	0.0330	0.0000	1.0000
19	0.9780	0.0220	0.0000	1.0000
20	0.9670	0.0330	0.0000	1.0000
21	0.9780	0.0220	0.0000	1.0000
22	0.9780	0.0220	0.0000	1.0000
23	0.9890	0.0110	0.0000	1.0000
24	0.9890	0.0110	0.0000	1.0000
25	0.9780	0.0220	0.0000	1.0000
26	1.0000	0.0000	0.0000	1.0000
27	1.0000	0.0000	0.0000	1.0000
28	1.0000	0.0000	0.0000	1.0000
29	1.0000	0.0000	0.0000	1.0000
30	1.0000	0.0000	0.0000	1.0000