



FLIR thermal imaging cameras confirm effectiveness of regional anesthetics

'Each operation room should include a FLIR thermal imaging camera'

For many operations the use of regional anesthetics is preferred to general anesthetics, since it is considered to be safer for the patient. To determine the effectiveness of regional anesthetics the patient is subjected to pinpricks. If the patient indicates a pain sensation then the regional anesthetics is considered to be ineffective. Not only is the pinprick method subjective, it is also useless if the patient is unable to communicate. Furthermore it takes approximately 30 minutes before the pinprick method can be used to reliably determine the success of a local regional block. Researchers at the Erasmus University Medical Center, Rotterdam, the Netherlands, have found a new and objective tool to determine the effectiveness of the regional anesthetics: FLIR thermal imaging cameras.

Accurate assessment of the effectiveness of regional blocks is of vital importance, according to Dr. Ir. Sjoerd Niehof from the Anesthesiology Department of the Erasmus University Medical Center. "Quick and accurate identification of failed blocks allows the anesthesiologist to take appropriate action, such as administering additional anesthetics, in an early stage. This will not only help to avoid unnecessary operation room delays, but will also help limiting the administration of additional anesthetics to clinically appropriate situations. This is important because administering additional injections carries a small but definite risk of morbidity. In other words: the accurate assessment of regional blocks will help to save lives."

Niehof compared several different methods including FLIR thermal imaging cameras. "Thermal imaging provides immediate feedback.

Medical personnel can use a FLIR thermal imaging camera to objectively determine the effectiveness of the regional anesthetics. If the regional block is not effective it will clearly show in the thermal image."

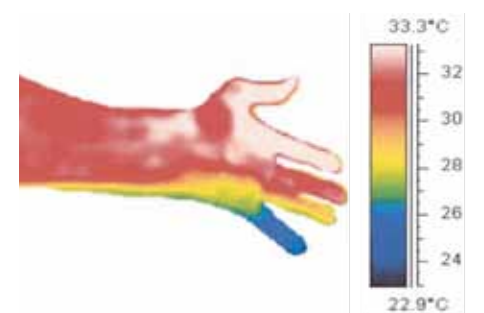
FLIR i3 and i5

The researchers initially used a FLIR SC2000 Series thermal imaging camera with an uncooled microbolometer detector that produces thermal images with a resolution of 320 x 240 pixels. Later trials showed that lower-end models such as the FLIR i5 and FLIR i3, that produce thermal images with resolutions of respectively 80 x 80 pixels and 60 x 60 pixels, can also be used for this application.

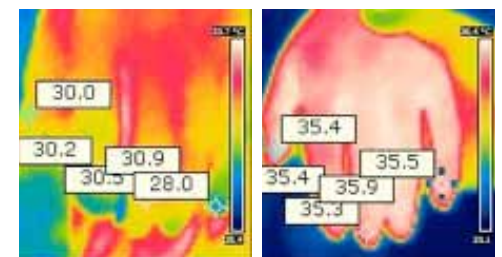
"As a response to the regional anesthetics the blood vessels dilate, a phenomenon called vasodilatation", explains Niehof. "This leads



The affordable FLIR i3 and i5 entrance models are perfectly adequate for this application according to Niehof.



This thermal image, taken with the FLIR SC2000 Series thermal imaging camera shows a cold pink, indicating that the ulnar nerve is not anesthetized.



Two thermal images from a FLIR i5 taken just before and 30 minutes after administering regional anesthetics. The rise in temperature indicates that the regional block is effective.

to an increased blood flow and subsequently to an increased skin temperature in the area affected. In our research we found that in case of a successful regional block the



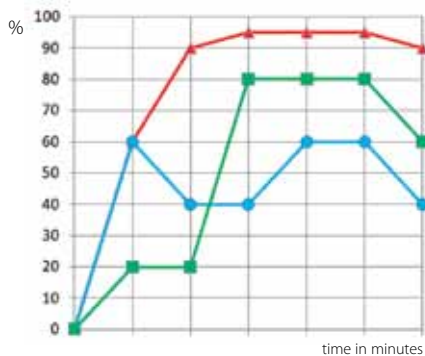
skin temperature rises with 4.5 °C in about 20 minutes. In case of a non-effective block the maximum temperature difference was just 0.8 °C. This difference in temperature increase can be detected and documented using a FLIR thermal imaging camera."

Finding test subjects was relatively easy, according to Niehof. "We approached patients at the University Medical Center that were to undergo surgery on the hand or forearm and asked them to participate. Thermal imaging is a non invasive method, so it is completely safe and it doesn't cause any inconvenience for the patient, so it was easy to find patients willing to cooperate."

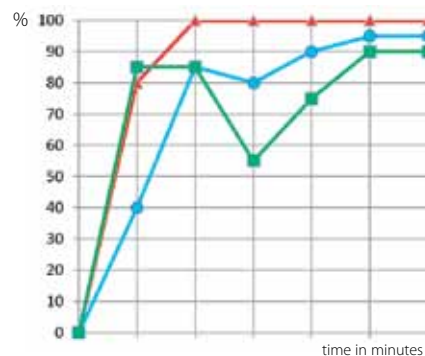
This resulted in a test group of 25 patients who were subjected to regional anesthetics (mepivacaine 1.5%). The effectiveness of the anesthetics was determined using three methods: the pinprick test, the cold sensation test or the thermal imaging test. From the moment the anesthetics were administered the effectiveness tests were executed every 5 minutes for a total duration of 30 minutes. The final check was made using a surgical forceps just before surgery.

Specificity of 100%

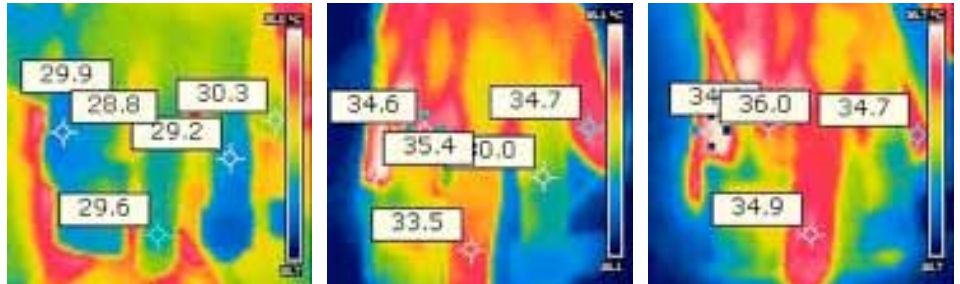
In medical diagnostics the terms sensitivity and specificity are used to determine the reliability



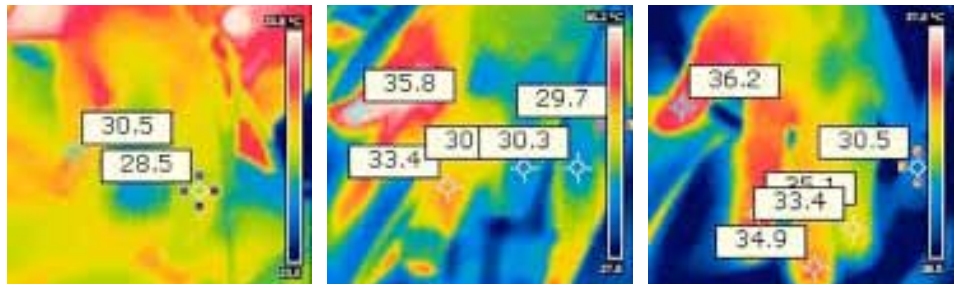
This chart shows the sensitivity of the thermal imaging (red), cold sensation (blue) and pinprick (green) assessment methods over time.



This chart shows the specificity of the thermal imaging (red), cold sensation (blue) and pinprick (green) assessment methods over time.



These thermal images (taken with a FLIR i5 thermal imaging camera) show a hand after regional anesthetics are administered. The increase in temperature shows that the regional block is successful in the area that will be operated.



In this case the pink finger and the surrounding area show little to no rise in temperature, indicating that the ulnar nerve is not anesthetized. General anesthetics were therefore administered prior to surgery.

of a test method. In this case sensitivity indicates the ability of a test method to correctly identify a successful regional block and specificity is the ability of the test to correctly identify a failed block. In other words: sensitivity is the percentage of people that have a successful regional block (as confirmed surgically) which have also been successfully identified as such using the test method, while specificity is the percentage of people that have a surgically confirmed failed block which have been successfully assessed using the test method.

The thermal imaging method has the best sensitivity and specificity. It reaches its maximum sensitivity of 95% at 15 minutes and maintains that for a period of 10 minutes, after which it drops to 90%. The pinprick reaches its maximum of 80% during the same time period. The cold sensation method reaches its maximum of 60% five minutes later and maintains it for a shorter duration. The specificity of thermal imaging reaches 100% after ten minutes, maintaining this level until the end of the 30 minutes. Both cold sensation and the pinprick methods reach their maximum much later, when 25 minutes have passed. Their maximum specificity is respectively 95 and 90%.

Point and click

From these results Niehof concluded that thermal imaging is the best method for regional block assessment. "Thermal imaging reaches higher accuracy values and maintains those high values for a longer period of time. And above all: it is a method that is completely objective, no patient input is required. At the same time it is extremely easy to use. All you need to do is point the FLIR thermal imaging camera and push the right button."

Worth the investment

According to Niehof local regional blocks should be assessed by a FLIR thermal imaging camera. "I don't see why not. The price is not a limiting factor anymore. Given the fact that it will help decrease morbidity risk by avoiding unnecessary additional anesthetics I would say that it is definitely worth the investment."

"And thermal imaging cameras can be used for more than just this particular application", continues Niehof. "Thermal imaging technology has seen use in the detection of certain, infections, nerve damage, soft tissue injuries, etc. Ongoing research is constantly revealing new and exciting ways to use thermal imaging technology as a medical monitoring and diagnostics tool."

Source: Galvin, E.M., et al., Thermographic temperature measurement compared with pinprick and cold sensation in predicting the effectiveness of regional blocks. *Anesth Analg*, 2006. 102(2): p. 598-604.

Disclaimer: all statements in this application story are based on the above-mentioned research. FLIR Systems cannot be held responsible for the use or misuse of any of its products in a medical environment.

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