Regional anaesthesia for upper limb

Aleksejs Miscuks
University of Latvia
Hospital of Traumatology and Orthopedics
Riga, Latvia

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Monitorings of Regional Anaesthesia (methods and its usefulness for upper limb)

- How do you confirm your block?
- What are the guidelines?
- Which methods exist?
- What we have to do more?
How do you confirm your block?

**Time sequence of sensory changes after upper extremity block: swelling sensation is an early and accurate predictor of success.**

*Paqueron X, Gentili ME, Willer JC, Coriat P, Riou B.*

Department of Anesthesiology, Centre Hospitalo-Universitaire Pitié-Salpêtrière, France. xavier.paqueron@psl.ap-hop-paris.fr

**Abstract**

**BACKGROUND:** Sensory assessment to estimate spread and effectiveness of a peripheral nerve block is difficult because no clinical test is specific for small sensory fibers. Occurrence of a swelling illusion (SI) during a peripheral nerve block corresponds to the impairment of small sensory fibers. The authors investigated the usefulness of SI in predicting successful peripheral nerve block by assessing the temporospatial correlation between progression of sensory impairment in cutaneous distributions anesthetized and localization of SI during peripheral nerve block installation.

**METHODS:** Interscalene, infracoracoid, or sciatic nerve blocks were performed using a nerve stimulator and 1.5% mepivacaine in 53 patients, with a total of 201 nerves to be anesthetized. Pinprick, cold, warm, touch, and proprioception were assessed every 3 min, while patients were asked to describe their perception of size and shape of their anesthetized limb and localization of these illusions. Data are presented as mean +/- SD and percentage (95% confidence interval).

**RESULTS:** Failure occurred in 12 cutaneous distributions out of a total of 201 theoretically blocked nerves. SI appeared earlier than warmth impairment (4.3 +/- 2.7 vs. 6.2 +/- 2.0 min; P < 0.05), always corresponding to successfully anesthetized cutaneous distributions, with the exception of 1 patient, who developed SI in 2 cutaneous distributions while sensory testing indicated failure in 1 distribution. SI successfully predicted the blockade of a cutaneous distribution with a sensitivity of 1.00 (0.98-1.00), a specificity of 0.92 (0.85-0.99), and an accuracy of 0.99 (0.97-1.00).

**CONCLUSIONS:** Swelling illusion may provide an early assessment of the success of a peripheral nerve block in unsedated patients.

How you may confirm your sensor block?

Neurologist guidelines renewed 2009

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\(^a\) Or other device providing graded vibratory stimuli; \(^b\) Or other device providing graded thermal stimuli; QST: quantitative sensory testing; SEP: somatosensory-evoked potentials; LEP: laser-evoked potentials.

EFNS 2004 : Eur J Neurol, 11, p153-162
How you may confirm your sensor block?

Pinprick, cold, warm, touch, and proprioception were assessed


Borgeat A, Aguirre J; Sedation and regional anesthesia: Current Opinion in Anaesthesiology (July 2009).
Quantitative methods

QST
Quantitative sensory testing

- Termal detection
- Tactile detection thresholds
- Mechanical pain threshold
- Stimulation/responce function
- Mechanical pain sensitivity
- Mind-up ratio
- Vibration detection threshold
- Pressure pain threshold

Weighted needle pinprick sensory thresholds: a simple test of sensory function in diabetic peripheral neuropathy.

Therefore, in order to measure pain levels precisely, we realized a need to combine the fine motor and sensory attributes of manual palpation with precision measurement made with pressure gauges, and thus conceived the notion of Palpometry. A prototype Palpometer was designed, originally called an electronic dolorimeter.
How you may confirm your autonomic block? (sympathetic)

● Thermography


● Thermometry


Affiliations of authors:¹University of Latvia, ²Institute of Atomic Physics and Spectroscopy, ³The Faculty of Medicine; 2010, NWAC, Dubaj
Quantitative methods

Functional MRI

Multi-stage analysis with coincidence

Left Hand: Finger Thumb Tapping

Penfield’s Motor Homunculus
How you may confirm your autonomic block?

- Electrical stimulation and pain treasholds control
- Electrodermal activity (EDA). Control of skin conductivity

The assessment of postoperative pain by monitoring conductance: results of a prospective study*
How you may confirm your autonomic block?

- **Pulsoximetry**

  Pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anesthesia.


- **Peripheral flow index**

  Peripheral flow index is a reliable and early indicator of regional block success.

Photoplethysmography imaging (PPGI) is a non-invasive technique for detection of blood flow pulsations in skin using backscattered optical radiation.
The lamp for surgery ALM Prismalix PRX800 was used as a source of light.

For video shooting was used HD video camera Sony HDR-SR1 Handycam®. Videos were taken 20 min. with resolution of 1440x1080 pixels at 25 interlaced frames per second.

Video content was stored to computer HDD for off-line processing.
Temperature sensor placed on the wrist and the temperature was measured every minute. Non-contact monitoring of skin area was taken by camcorder.
The algorithm

- Video file
- Image sequence
- Filtering: Gaussian blur, color filter
- Intensity at every pixel of image
- Green light for RA monitoring
- Intensity variations over time
The algorithm

Fourier spectrum of intensity variations

Peak value of spectrum in band 0.7-1.5Hz

Normalizing values between 0-255

Graphical representation of PPG image map

Averaged PPGI amplitude dynamics

Filtered frames

Averaged amplitude in time

Fourier spectrum

Frequency domain

Frequency, Hz
RA (n.medianus) performed by US+PNS technique
Results

Video example of PPG amplitude mapping from hand palm

Non-contact PPGI method allows monitoring of skin blood perfusion in real time
The software of video processing
The amplitude of blood pulsations increases after RA input, and the 2-D distribution of PPG amplitude changes in time.
Results show statistically significant correlation between temperature and amplitude of PPGI signal (statistical values $r=0.96$, $p<0.0001$).
Correlation coefficients between skin temperature and amplitude of PPGI for different subjects

Mean value of correlation coefficient showed statistically significant value $r=0.8 \pm 0.14$ ($p<0.0001$)
Video example of PPG amplitude mapping from hand palm
Conclusion

• Our results show that it is possible to detect blood pulsations in skin surface using consumer-type video camera

• The non-contact PPGI technique has been shown to be capable of detecting effect of local anaesthesia in upper arms
Thank you for your attention!