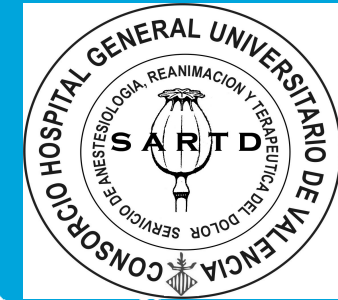




CONSORCI
HOSPITAL GENERAL
UNIVERSITARI
VALÈNCIA



Monitorización de la analgesia

Emilio Matute

Servicio de Anestesia

Hospital La Moraleja. MADRID.

SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011



Conflicto de intereses

No relación contractual con GE, Covidian (ni Aspect Medical)

Conferencias para Aspect Medical y GE en Congresos No remuneradas

Financiación del Ensayo Clínico Multicéntrico Internacional ADVANCE gestionado por la Fundación Sanitas

Prestamo por GE del monitor SPI para realizar diferentes ensayos clínicos

Apoyo económico de GE para presentar los resultados de la investigación en el Congreso ASA 2011

Agradecimiento: A mis compañeros del hospital, co-autores o no de la presente exposición

**SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011**



Profundidad anestésica

- Balance dinámico entre la concentración de los fármacos hipnóticos y analgésicos en el lugar del efecto, y la intensidad de la estimulación quirúrgica.

Plano anestésico
inadecuado



Plano anestésico
excesivo

- Factores:
 - Tipo de cirugía
 - Tipo de anestesia
 - Variabilidad interindividual

“... Not only must we not give too much anesthesia, we must not give too little ...” Edmond I Eger II.

Consciousness

Nociception

Neuro-
muscular
function



BIS
Entropy



Train-of-
Four

SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



Consciousness

Nociception

Neuro-
muscular
function



BP, HR,
F-EMG,
Pulse wave
etc.

SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011

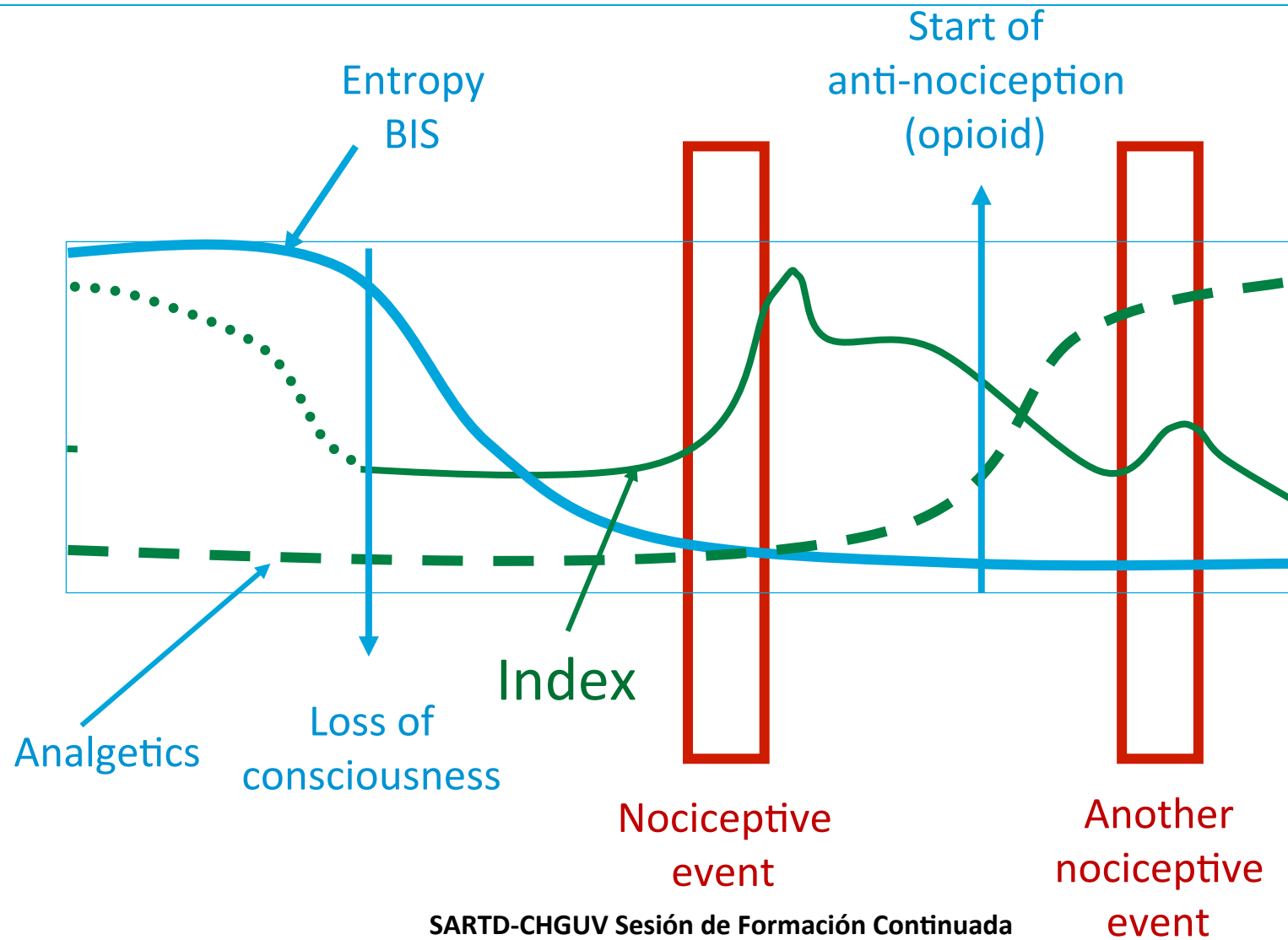


Measurement of nociception

- Premise:
Nociception elicits a response, which is counteracted by anti-nociceptive medication
- Nociception is unconscious perception of noxious stimulus, *detected as reactions of the body*
- Adequate nociceptive – anti-nociceptive balance:
Noxious stimulus → no perception → no response



Measurement of nociception



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011

High variability in the need of opioids

Pain. 2004 Jun;109(3):481-7.

Gender differences in post-operative pain and patient controlled analgesia use among adolescent surgical patients.

Logan DE, Rose JB.

The Children's Hospital of Philadelphia, 34th Street and Civic Center Boulevard, Philadelphia, PA 19104, USA. deirdre.logan@childrens.harvard.edu

Mol Pain. 2009 Jun 23;5:32.

Ethnicity and OPRM variant independently predict pain perception and patient-controlled analgesia usage for post-operative pain.

Tan EC, Lim EC, Teo YY, Lim Y, Law HY, Sia AT.

KK Research Centre, KK Women's and Children's Hospital, Singapore. tanec@bigfoot.com

Clin Geriatr Med. 2001 Aug;17(3):433-56, v-vi.

Age-related differences in pain perception and report.

Gibson SJ, Helme RD.

Department of Medicine, University of Melbourne, Melbourne, Victoria, Australia.

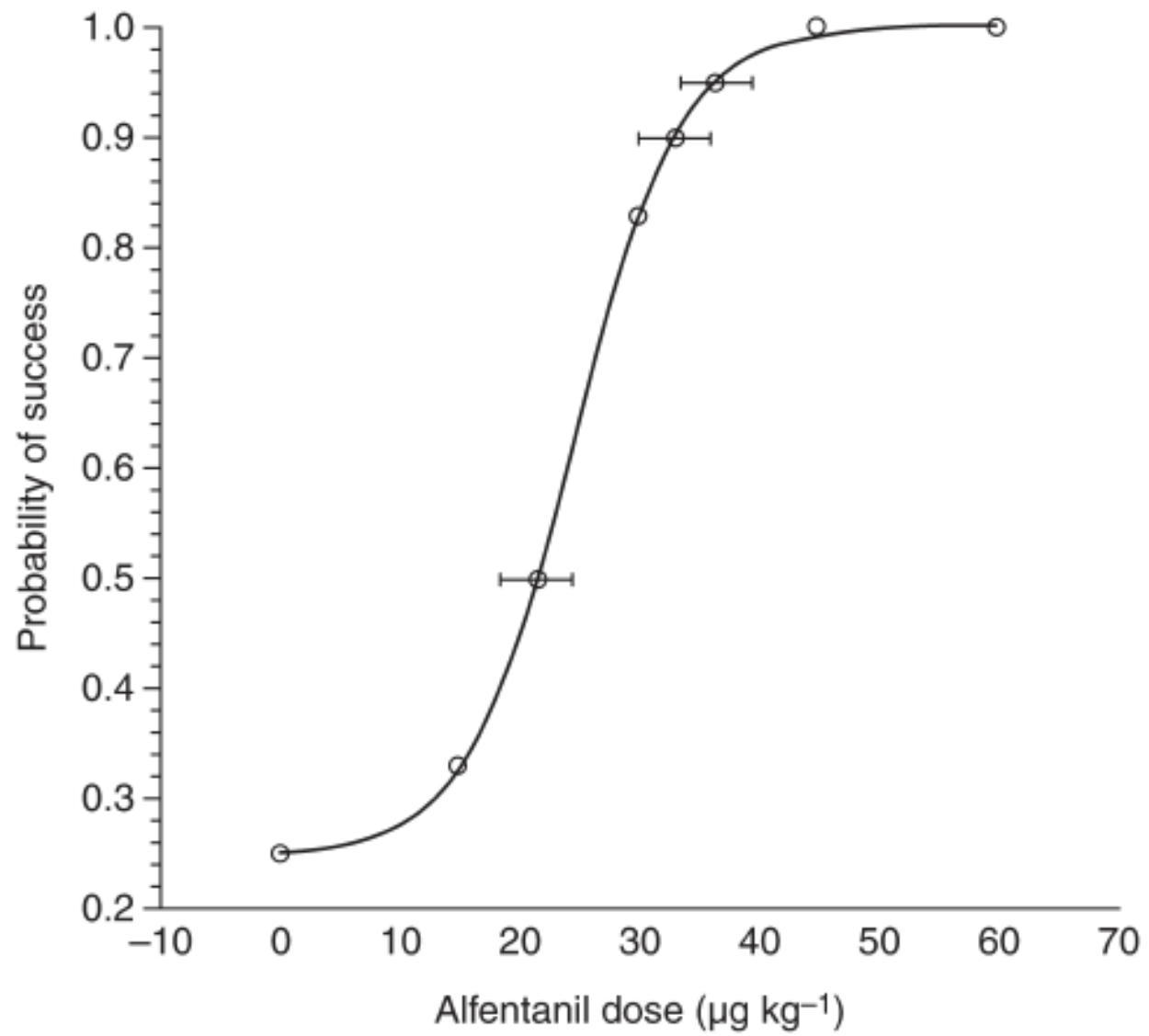
Anesthesiology. 2006 Aug;105(2):235-7.

One size does not fit all: genetic variability of mu-opioid receptor and postoperative morphine consumption.

Landau R.

SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011





SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011



Human Opioid Receptor A118G Polymorphism Affects Intravenous Patient-controlled Analgesia Morphine Consumption after Total Abdominal Hysterectomy

Wen-Ying Chou, M.D.,* Cheng-Haung Wang, M.D.,† Ping-Hsin Liu, M.D.,* Chien-Cheng Liu, M.D.,* Chia-Chih Tseng, M.D.,‡ Bruno Jawan, M.D.§

Table 4. Morphine Consumption in the First and Second 24 Hours

	AA (n = 43)	AG (n = 19)	GG (n = 18)
Day 1 morphine dose, mg/24 h	27.11 ± 9.57	29.46 ± 8.79	33.32 ± 10.49*
Day 2 morphine dose, mg/24 h	9.59 ± 6.70	11.09 ± 10.60	10.51 ± 6.23
Total morphine dose, mg	37.75 ± 12.32	41.58 ± 17.79	43.97 ± 13.92

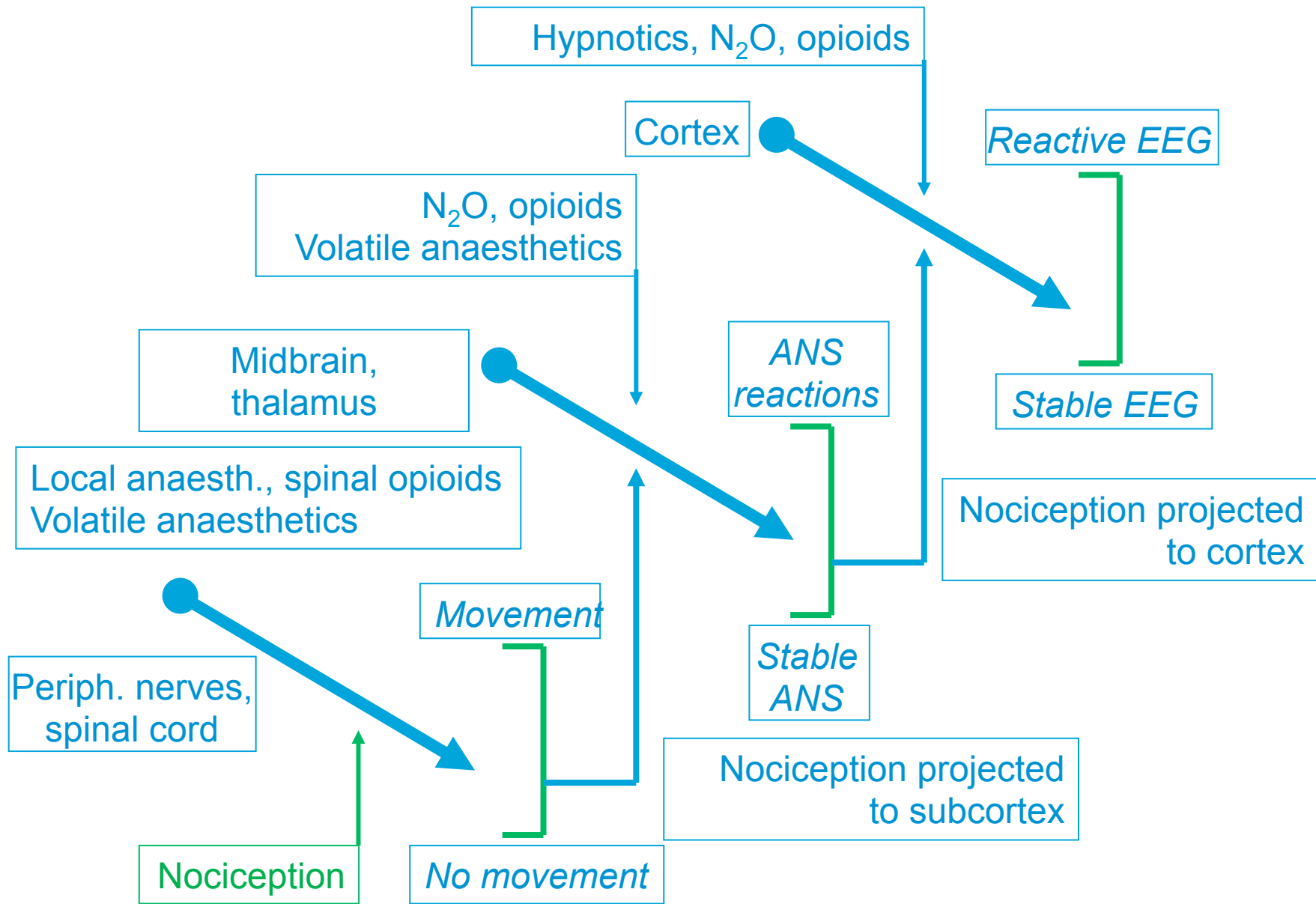
Data are expressed as mean ± SD.

P value for one-way analysis of variance with *post hoc* tests (*P* < 0.05 shows statistically significant difference). * *P* = 0.024 for differences in morphine doses between AA and GG.

AA = wild homozygous; AG = mutant heterozygous; GG = mutant homozygous.

SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011





SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



EEG spectral entropy, heart rate, photoplethysmography and motor responses to skin incision during sevoflurane anaesthesia

E. R. J. SEITSONEN¹, I. K. J. KORHONEN², M. J. VAN GILS², M. HUIKU³, J. M. P. LÖTJÖNEN², K. T. KORTILA¹ and A. M. YLI-HANKALA⁴

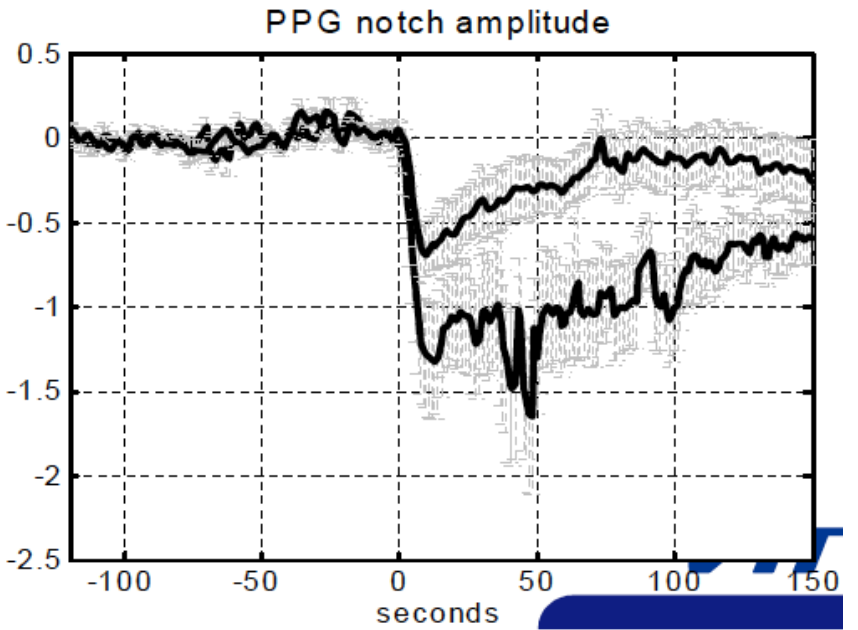
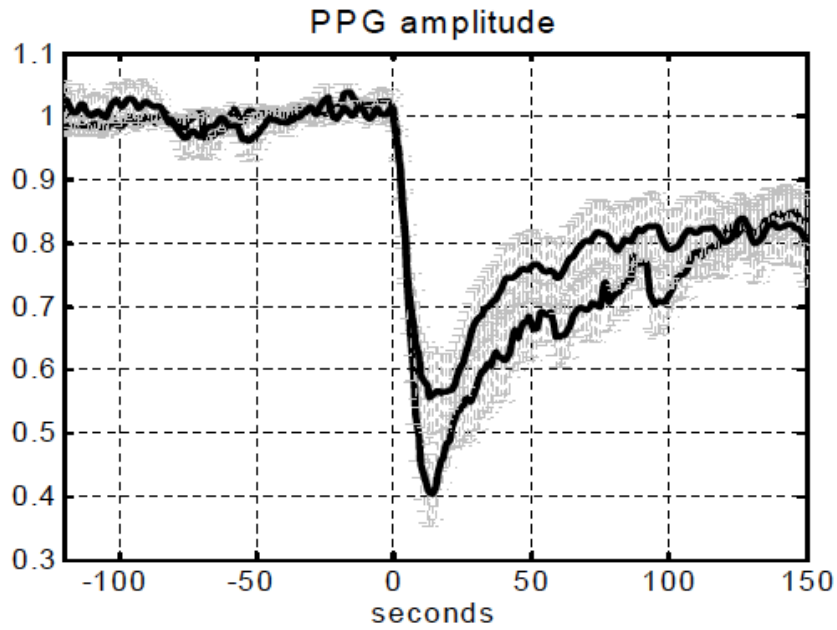
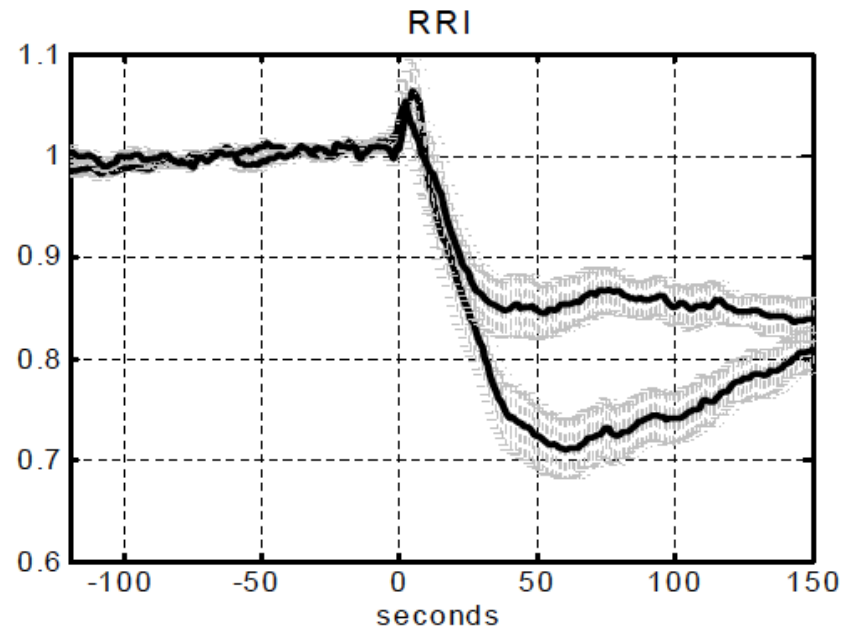
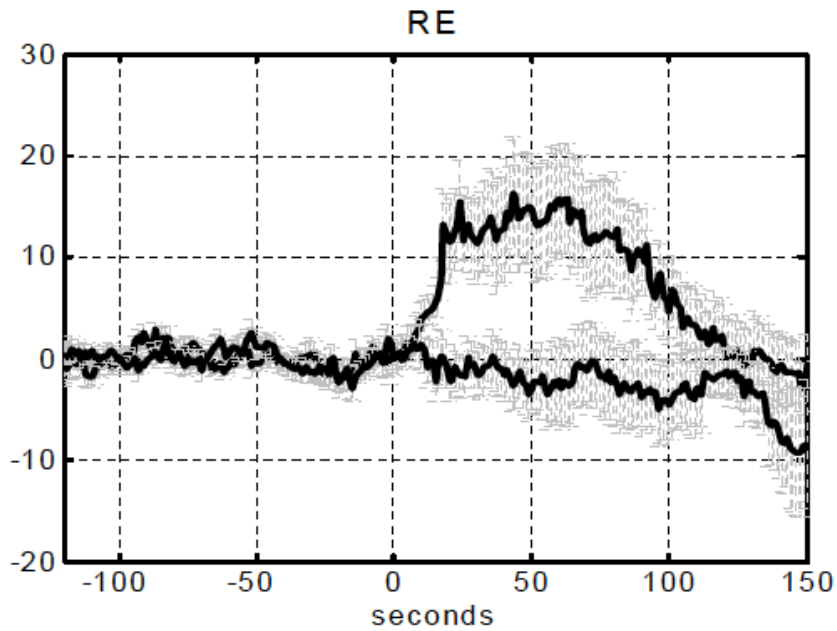
¹Department of Anaesthesia and Intensive Care, Helsinki University Hospital, Helsinki, Finland, ²VTT Information Technology, Tampere, Finland, ³Datex-Ohmeda Division, Instrumentarium Corporation, Helsinki, Finland, ⁴Department of Anaesthesia, Tampere University Hospital, and University of Tampere, Medical School, Tampere, Finland

- 26 patients scheduled for abdominal hysterectomy
- Protocol
 - Induction: fentanyl 1 µg/kg iv + propofol 1 mg/kg iv
 - Sevoflurane 8% in 100% oxygen via facial mask until endotracheal intubation, then 0.8 MAC (1.6% end-tidal)
 - Any signs of arousal at skin incision were registered
 - => movers (N=12)
 - => nonmovers (N=14)
 - **Movement response to incision was considered as a sign of significant nociception.**
- Analysis of responses to incision
 - Normalisation to pre-incision values
 - Comparison of movers (supramaximal nociception) and non-movers (submaximal nociception)
 - Several processed parameters: RRI, HRV, PPG, PPGV, EEG (RE, SE, SEF95), fEMG
 - Detection of nociception (sign of which the movement is supposed to be) on basis of the response



SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011

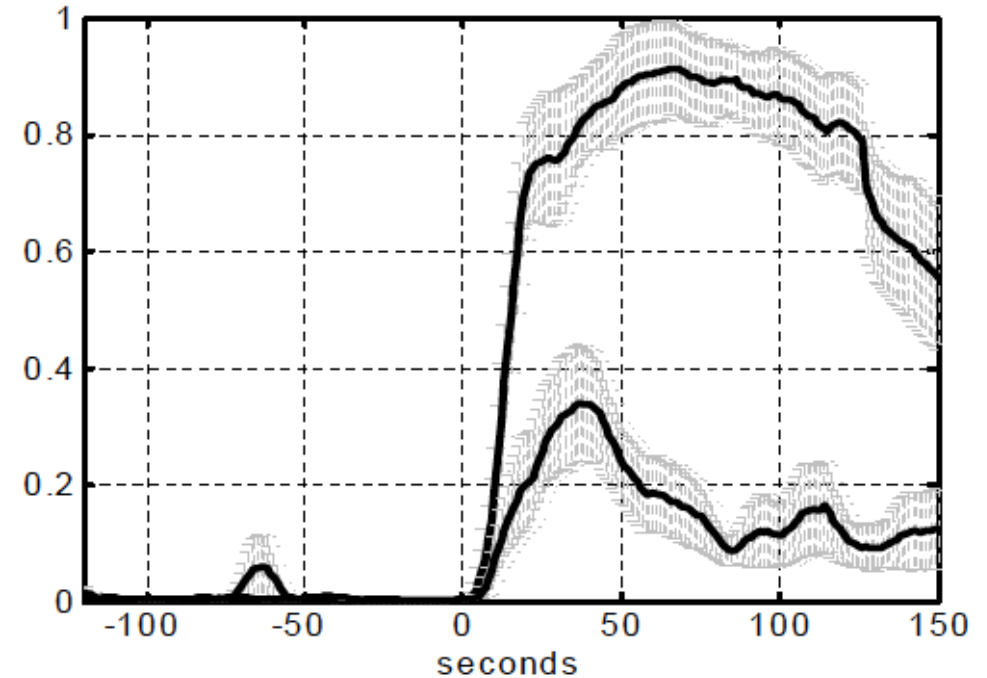




SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



- A classifier combining RRI, RE and PPG notch amplitude was developed by logistic regression
- A promising result: it seems to be possible to detect supramaximal nociception during general anaesthesia
 - NMBAs?
 - Motor response as only reference is not sufficient



Classifier uses variables	Overall performance	Sensitivity	Specificity
RE & RRI & PPG notch amplitude	96% (21/22)	90% (9/10)	100% (12/12)
RE & RRI	91% (20/22)	90% (9/10)	92% (11/12)
RE & PPG notch amplitude	91% (20/22)	90% (9/10)	92% (11/12)
RRI & PPG notch amplitude	73% (19/26)	58% (7/12)	86% (12/14)
RE	77% (17/22)	70% (7/10)	86% (12/14)
RRI	73% (19/26)	58% (7/12)	86% (12/14)
PPG notch amplitude	65% (17/26)	50% (6/12)	79% (11/14)



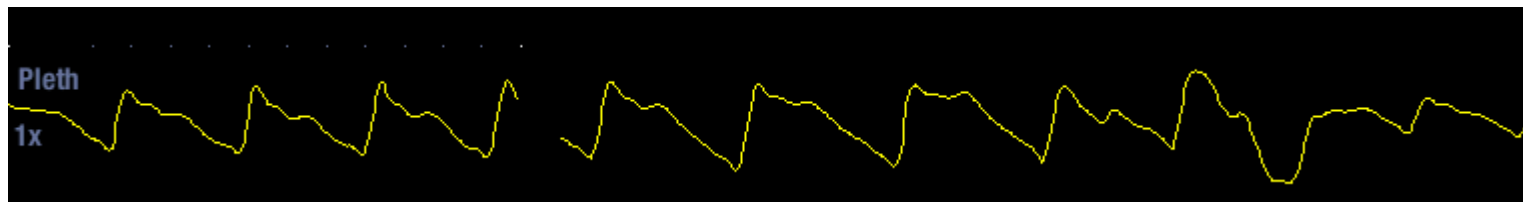
Stress pulsioximetry index (SPI)

La amplitud de la onda de pulso se relaciona con el volumen de sangre pulsátil en el dedo -> indicación de la perfusión periférica, volumen de sangre arterial...

El intervalo de la onda de pulso es un reflejo de la FC.

La amplitud y el intervalo pulso-pulso se modifican con el estímulo quirúrgico: vasoconstricción periférica y taquicardización

Ambos se obtienen de la onda de pulsioximetría, ya que el filtrado de dicha señal no es limitante.



SPI: Pletismograma y nocicepción

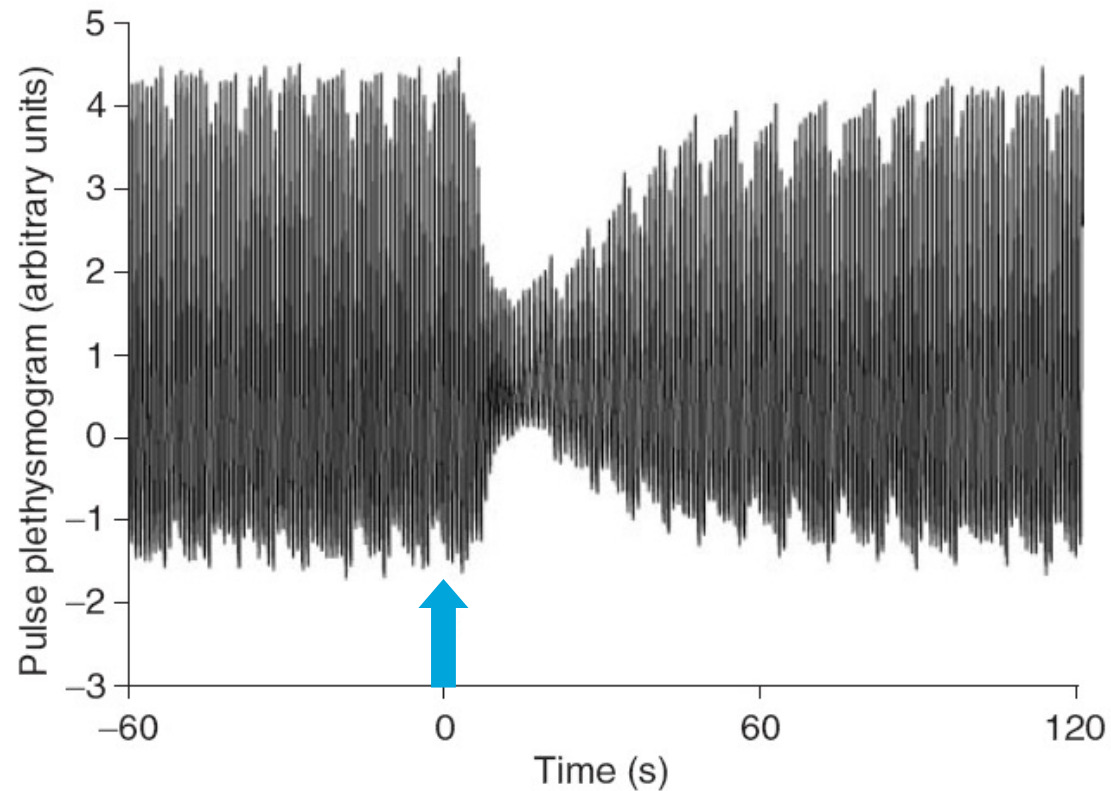


Fig. 1 PPG curve of a typical subject from 60 s before and 120 s after electrical stimulation of the ulnar nerve (arrow).

[Luginbühl M et al: Br J Anaesth 2006;96:323-329.](#)

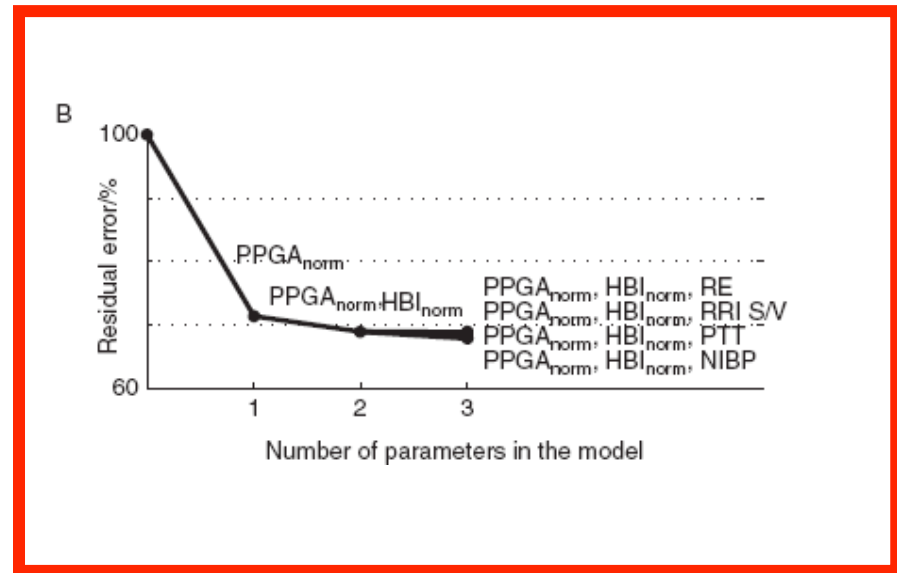
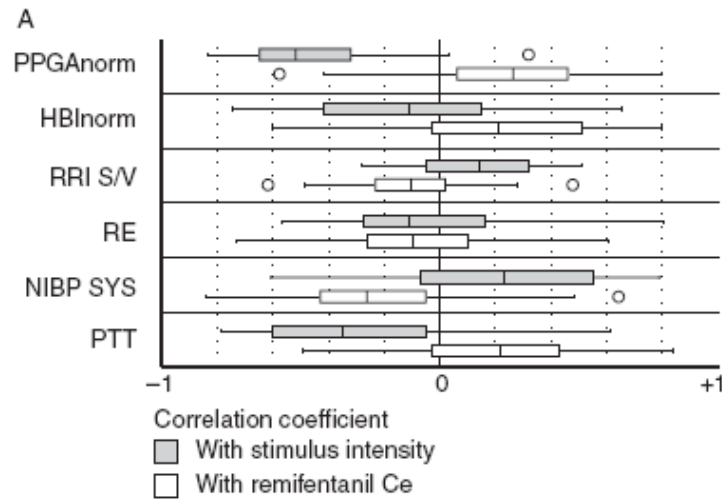
SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011

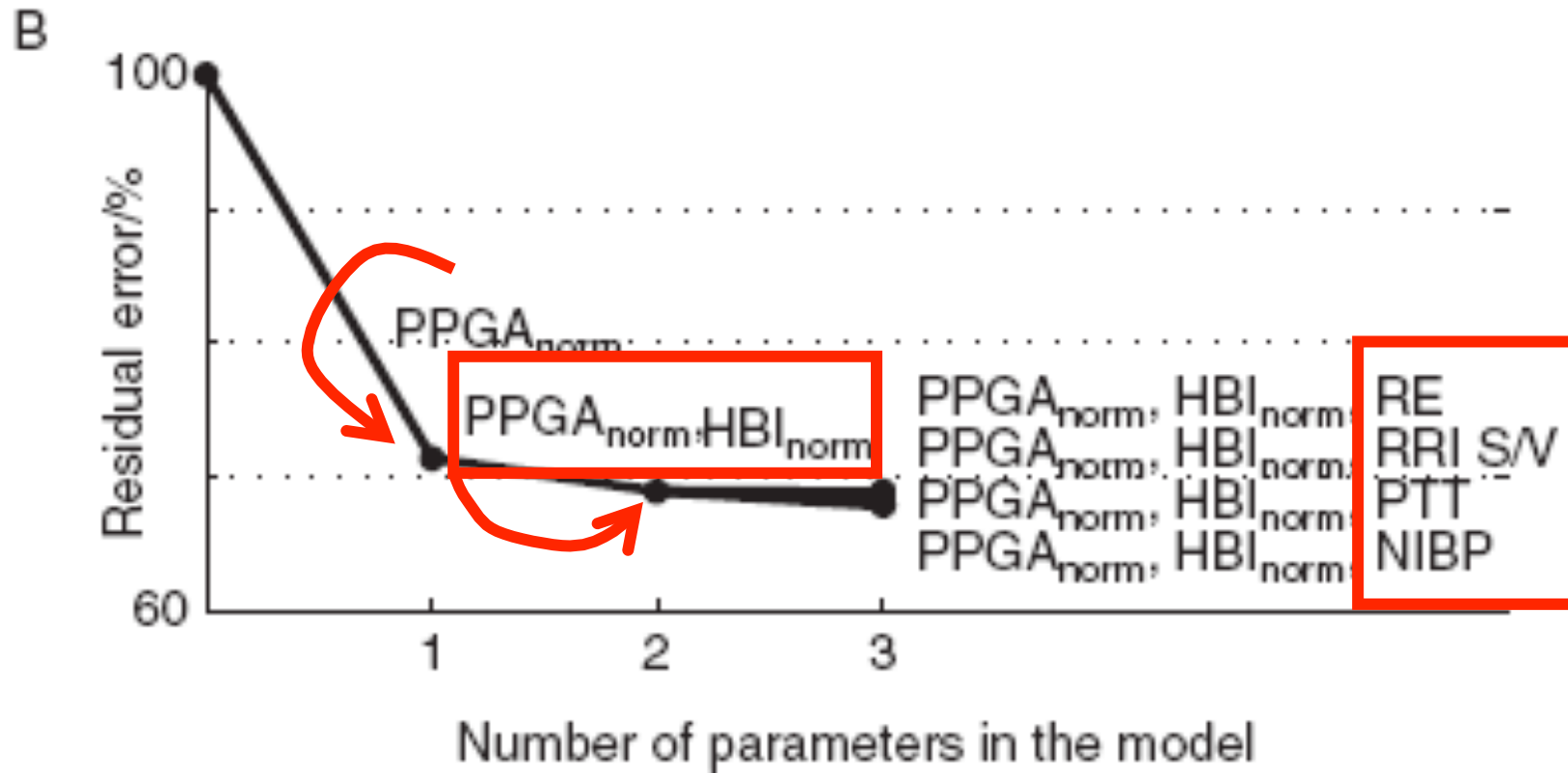


CLINICAL PRACTICE

Assessment of surgical stress during general anaesthesia

M. Huiku^{1*}†, K. Uutela¹†, M. van Gils², I. Korhonen², M. Kymäläinen¹†, P. Meriläinen¹†, M. Paloheimo^{1 3}†, M. Rantanen⁴†, P. Takala¹†, H. Viertiö-Oja¹† and A. Yli-Hankala^{4 5}†





SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



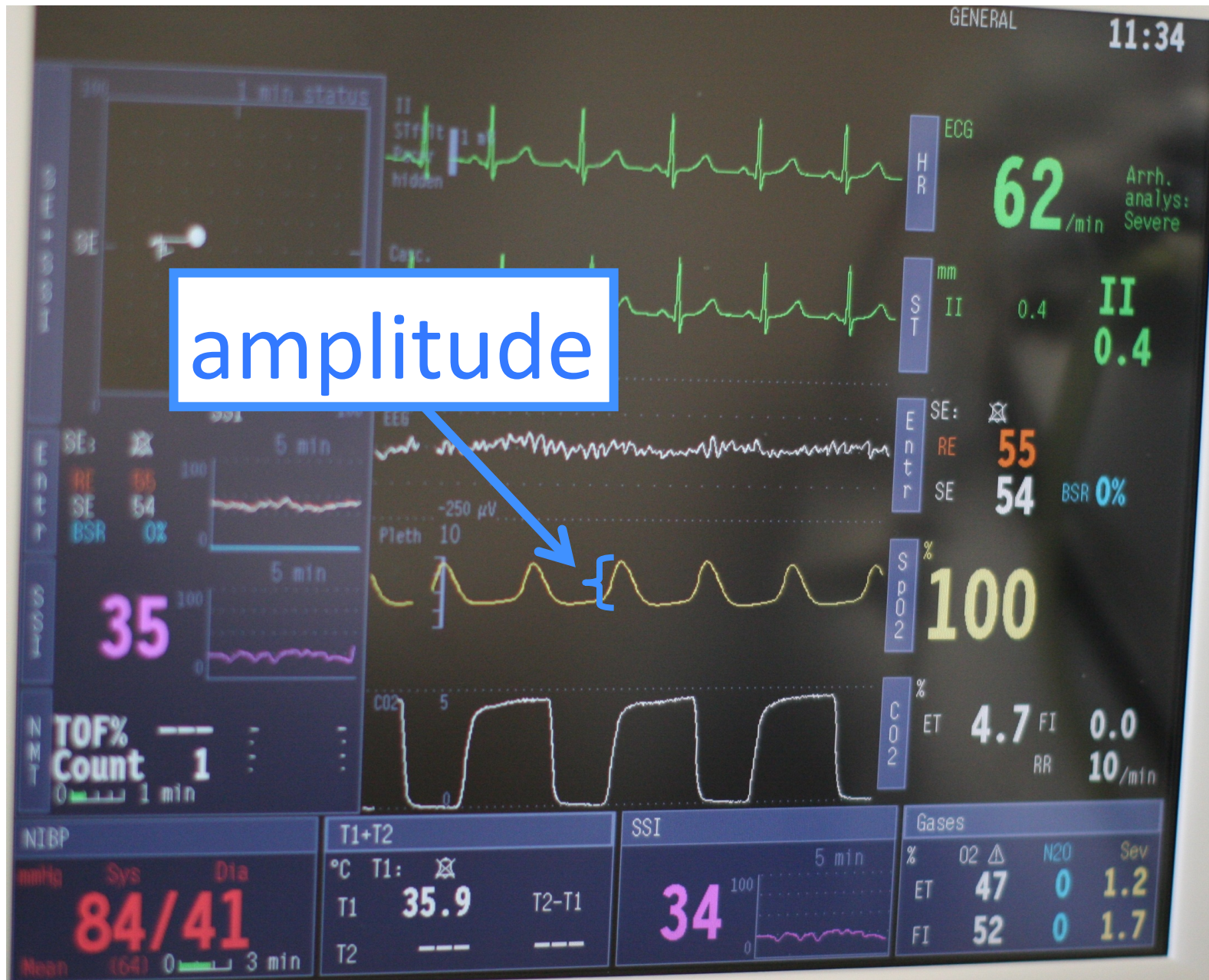
SPI: El Algoritmo – Descripción básica

El SPI se calcula a partir del pulsioxímetro

- **Amplitud pletismográfica del pulso (PPGA)**
 - Perfusión sanguínea periférica
 - Vasoconstricción periférica
 - Tono vasomotor periférico
- **Frecuencia de pulso latido a latido (PR)**
 - Balance simpático-parasimpático
 - Tono cardiaco simpático

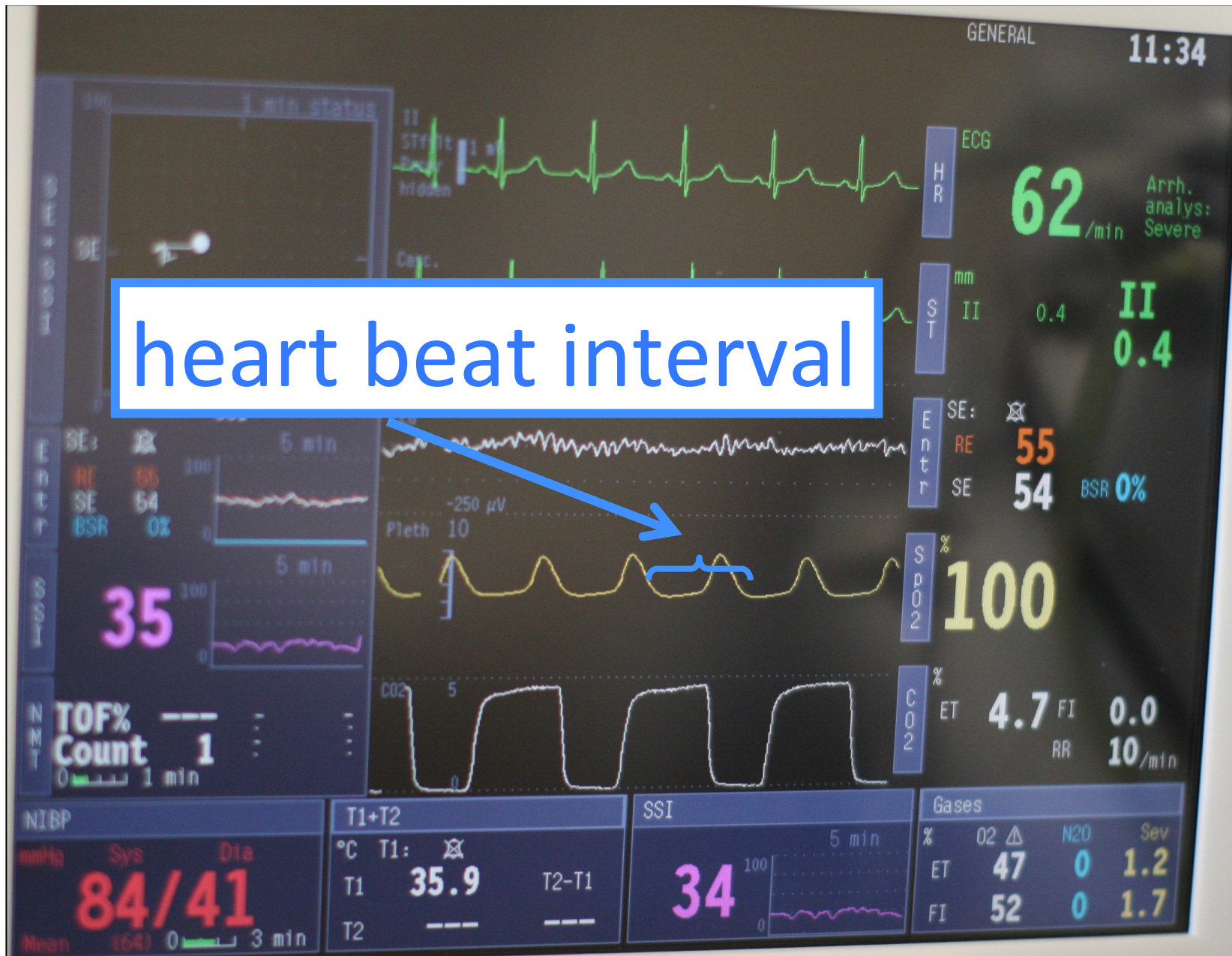
Ambos parámetros se normalizan antes de que se combinen para formar el SPI





SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011

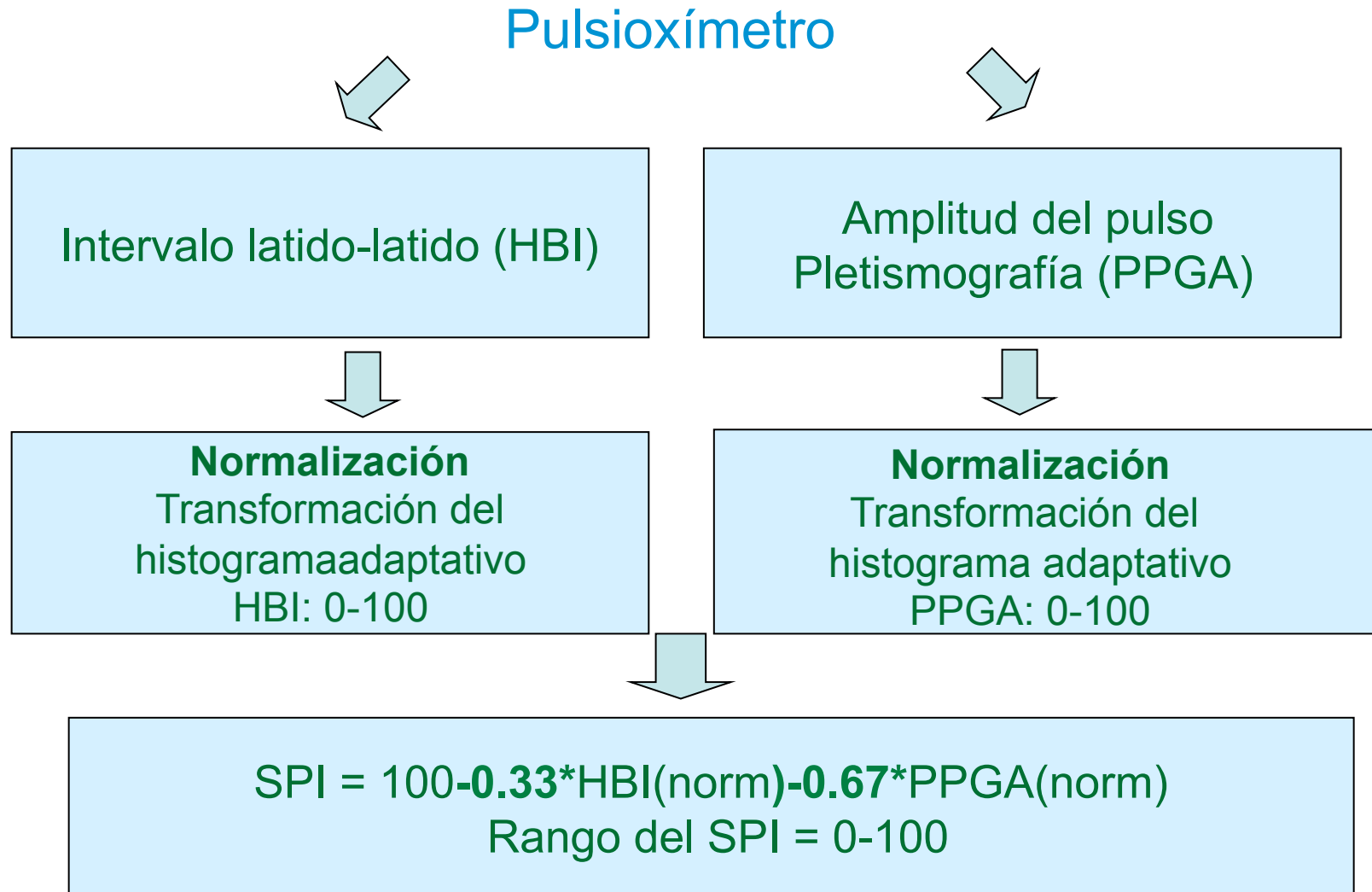




SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



SPI: Algoritmo del SPI



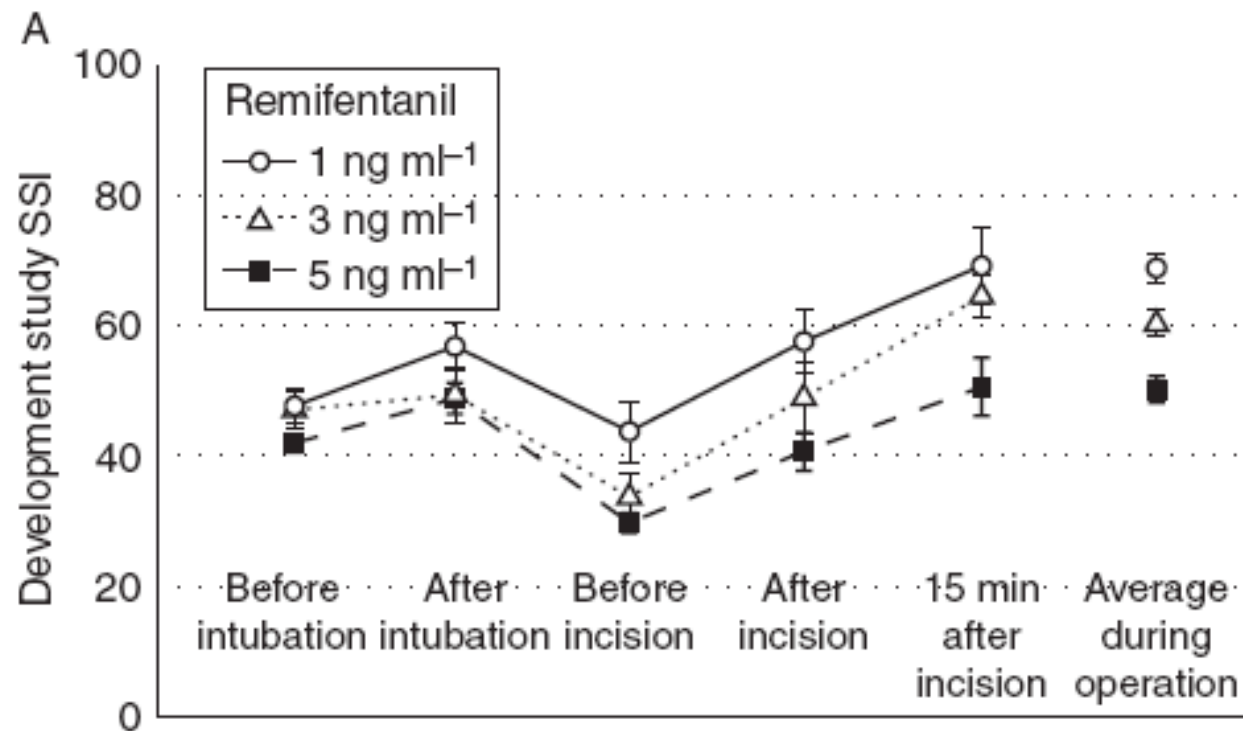
SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



CLINICAL PRACTICE

Assessment of surgical stress during general anaesthesia

M. Huiku^{1*}†, K. Uutela¹†, M. van Gils², I. Korhonen², M. Kymäläinen¹†, P. Meriläinen¹†, M. Paloheimo¹ 3†, M. Rantanen⁴†, P. Takala¹†, H. Viertiö-Oja¹† and A. Yli-Hankala⁴ 5†



SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011



Surgical stress index reflects surgical stress in gynaecological laparoscopic day-case surgery[†]

J. Ahonen^{1*}, R. Jokela¹, K. Uutela² and M. Huiku²

¹Department of Anaesthesia and Intensive Care Medicine, Helsinki University Hospital, Helsinki, Finland.

²GE Healthcare Finland, Helsinki, Finland

*Corresponding author: Department of Anaesthesia and Intensive Care Medicine, Helsinki University Hospital, PO Box 140, FIN-00029 HUS, Finland. E-mail: jouni.ahonen@fimnet.fi

30 adult, consenting females; gynaecological surgery

Desflurane to maintain SE of M-ENTROPY™ at 45 – 55

Remifentanyl or esmolol infusion to maintain systolic blood pressure within 85 – 115 % of baseline

Rocuronium boluses *q.s.*

Hypothesis: Esmolol has smaller effect on SPI than remifentanyl has

SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



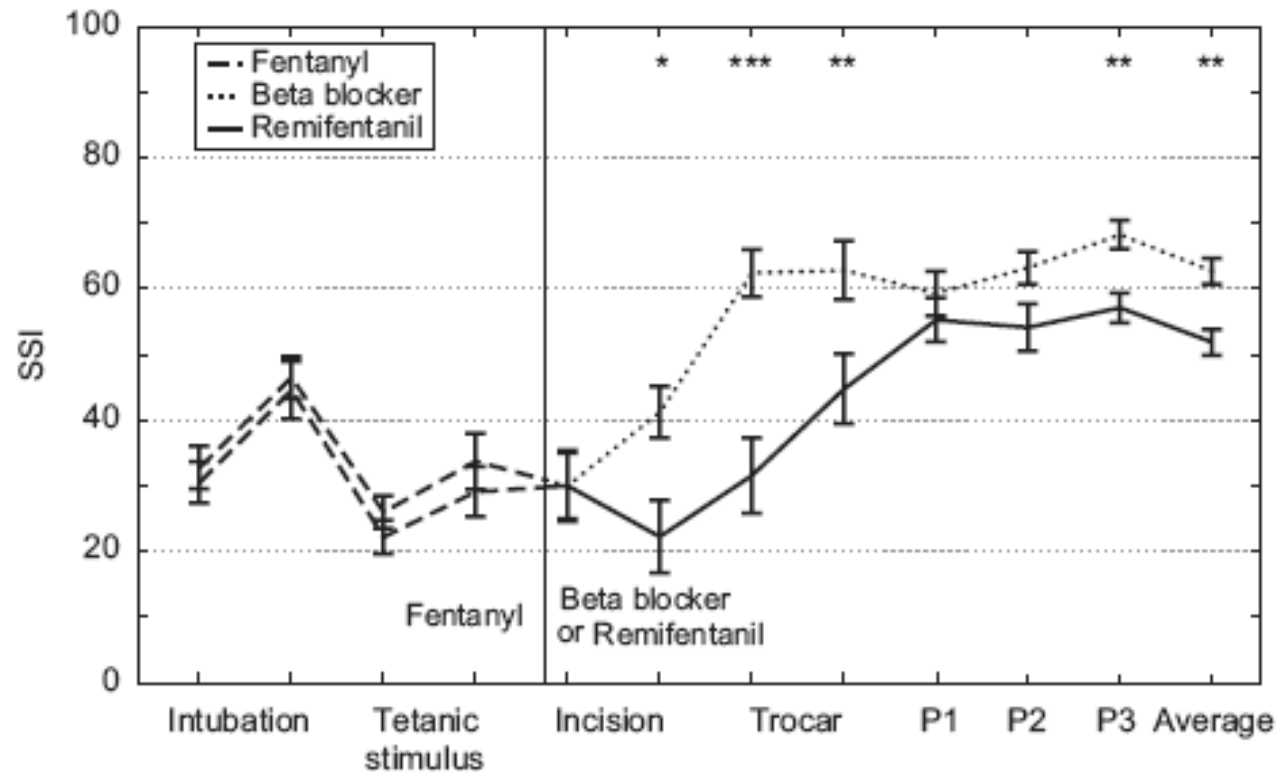


Fig 1 SSI recordings (mean SEM) during anaesthesia and surgery in patients receiving esmolol or remifentanil as a part of their general anaesthesia. P1, P2, and P3 represent average values during 2–12, 12–22, and 22–32 min after trocar insertion, respectively. * $P < 0.05$, ** $P < 0.01$, and *** $P < 0.001$.

SPI (ASA 2011, Chicago): Objetivos

Surgical plethysmographic index (SPI) correlates with different nociceptive stimuli during general anesthesia

We examined the relationship between nociception induced movement and SPI, during tetanic stimulation, laryngoscopy and skin incision under general anaesthesia.

The hypothesis of the study was that the degree of nociception, defined as the presence or absence of a movement response to nociceptive stimulus, can be detected by changes in SPI better than by other parameters.



SPI (ASA 2011, Chicago): Material y métodos

30 patients, laparoscopic cholecystectomy .

General anesthesia. Propofol (Ceprop) $7 \mu\text{g}\cdot\text{ml}^{-1}$, until loss of eyelash reflex, and then Ceprop at $3 \mu\text{g}\cdot\text{ml}^{-1}$ for 5 min, to reach a steady state.

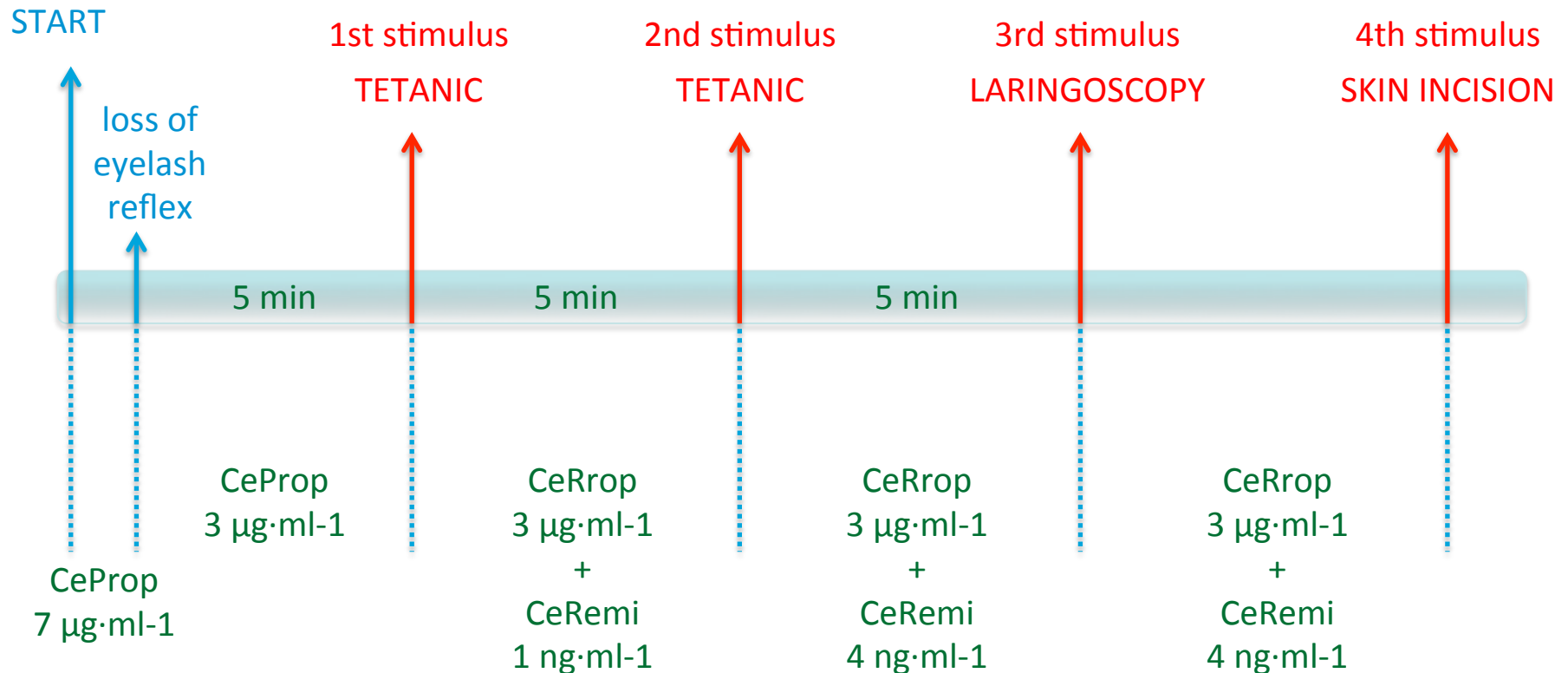
SPI, HR, MNIBP, SE were recorded continuously. Descriptions and times of motor responses to nociceptive stimuli were recorded.

- 4 stimuli:
- 1st stimulus: tetanic stimulus 80 mA, 100 Hz, 10 s
 - 2nd stimulus: tetanic stimulus 80 mA, 100 Hz, 10 s
 - 3rd stimulus: laryngoscopy
 - 4th stimulus: skin incision

SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011



SPI (ASA 2011, Chicago): Material y métodos



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



SPI (ASA 2011, Chicago): Material y métodos

Analysis to find out which values changed at each stimulus.

On the basis of the reaction of each patient to the nociceptive stimuli, data was classified into two groups: movers and non-movers.

The post-stimulus values were normalized with respect to their pre-stimulus values by subtracting the pre-stimulus value from the post-stimulus value.

The variables showing significant differences between movers and non-movers were entered in a logistic regression analysis to determine their predictive value with respect to the responder status.

SPI (ASA 2011, Chicago): Resultados

The number of patients who moved and did not move to the different stimuli varied.

The SPI values showed significant differences between the pre- and post-stimuli periods in all nociceptive stimuli, in both groups (movers and non-movers).

The pre- and post-stimuli SPI values were significantly higher in the group of movers compared with the group of non-movers.

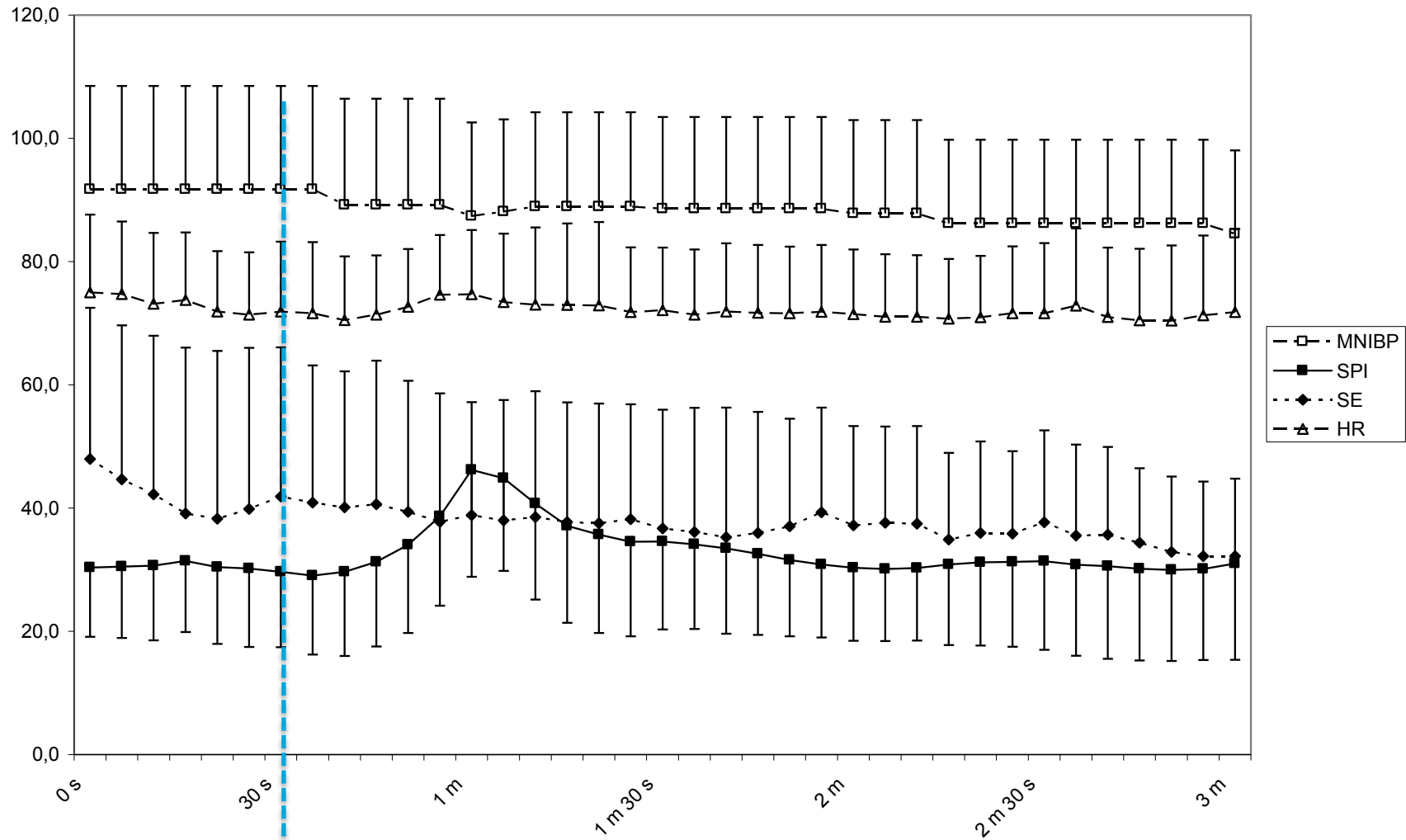
HR, NIBP, and SE do not increase between the pre- and post-stimuli periods.

SPI (ASA 2011, Chicago): Resultados

The normalized SPI post-stimulation values were the only ones that varied among the group of movers and non-movers.

The ability of SPI to predict movement response to nociceptive stimulus was compared with the changes in SPI values using logistic regression. With a probability of motor response = 0.5 as the cut-off point, were classified correctly 86.7% of the cases with 80% sensitivity and 90% specificity for the laryngoscopy stimulus.

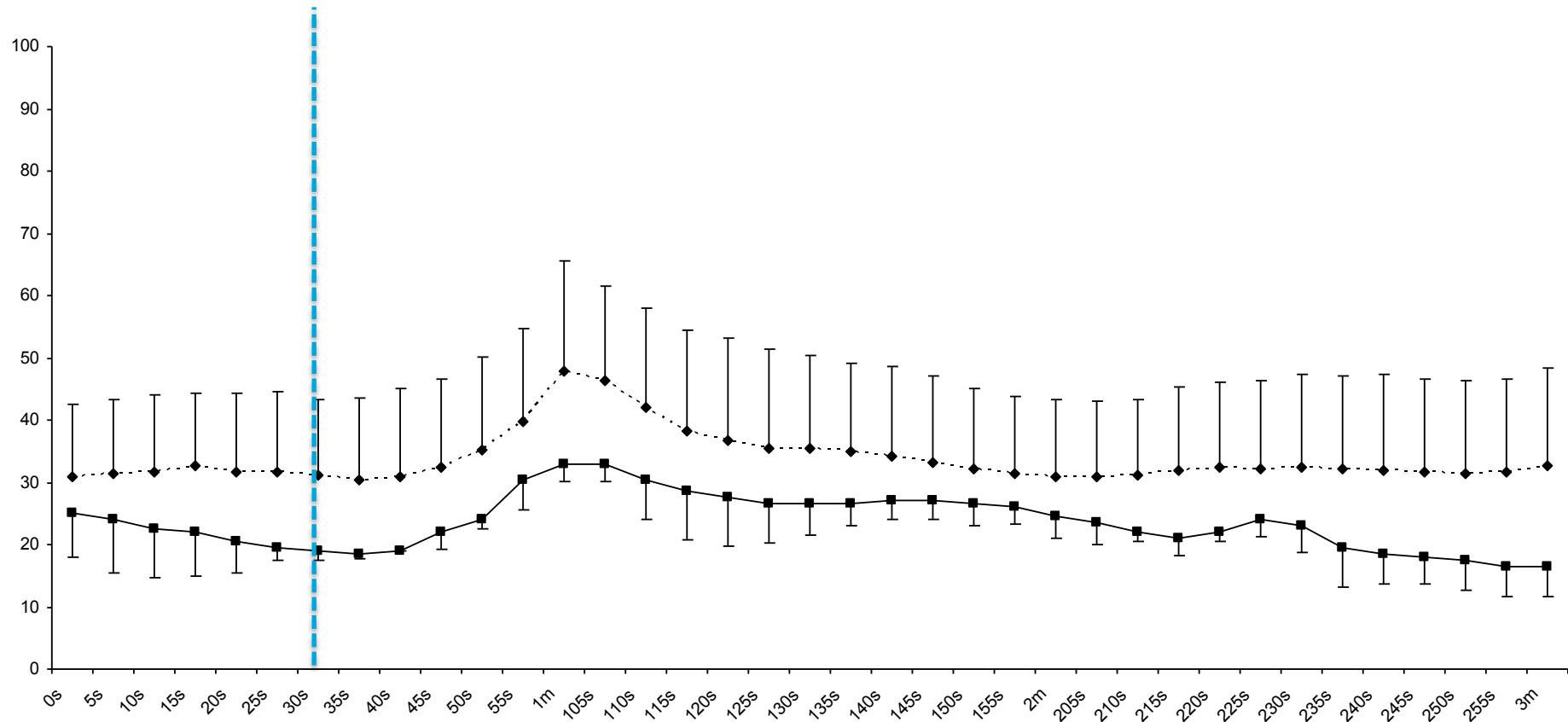
1º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



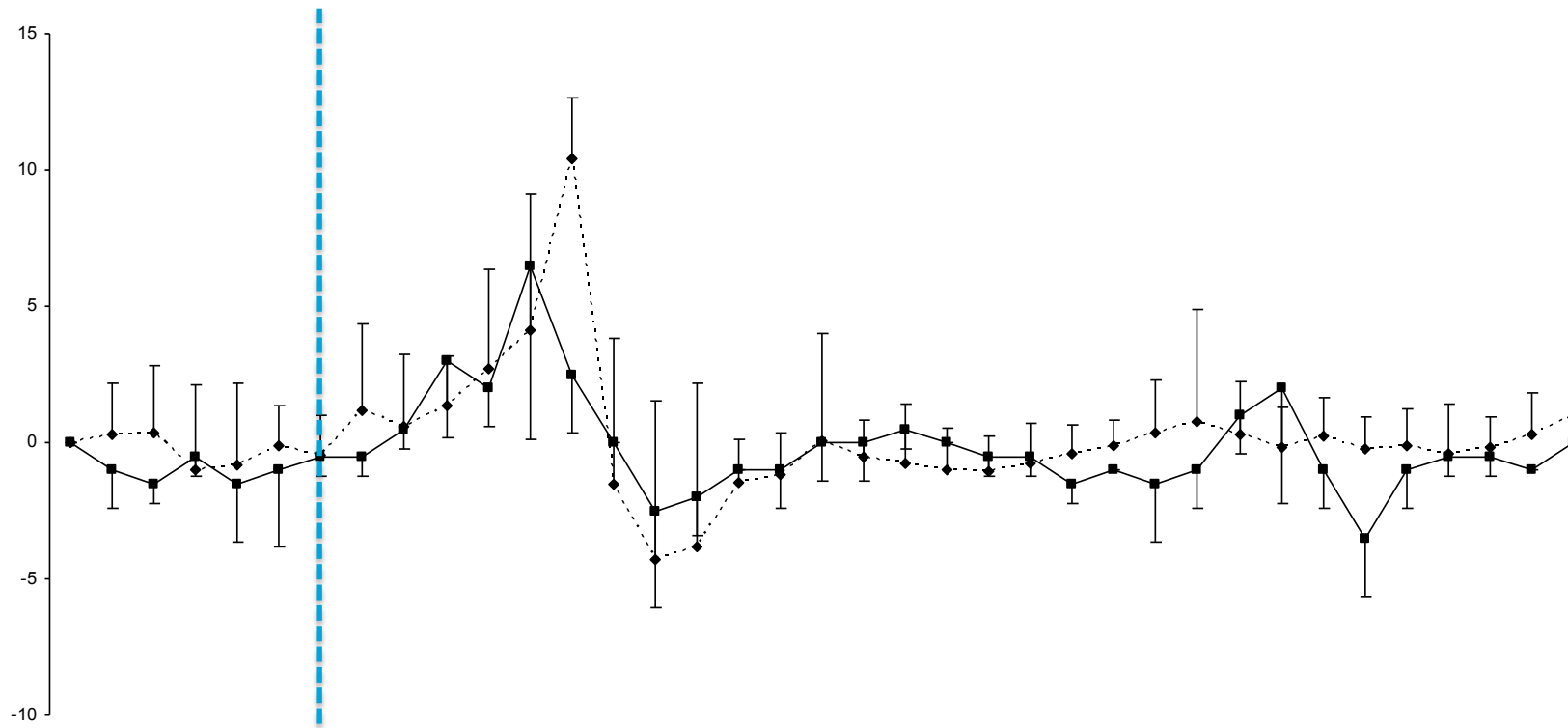
SPI 1º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



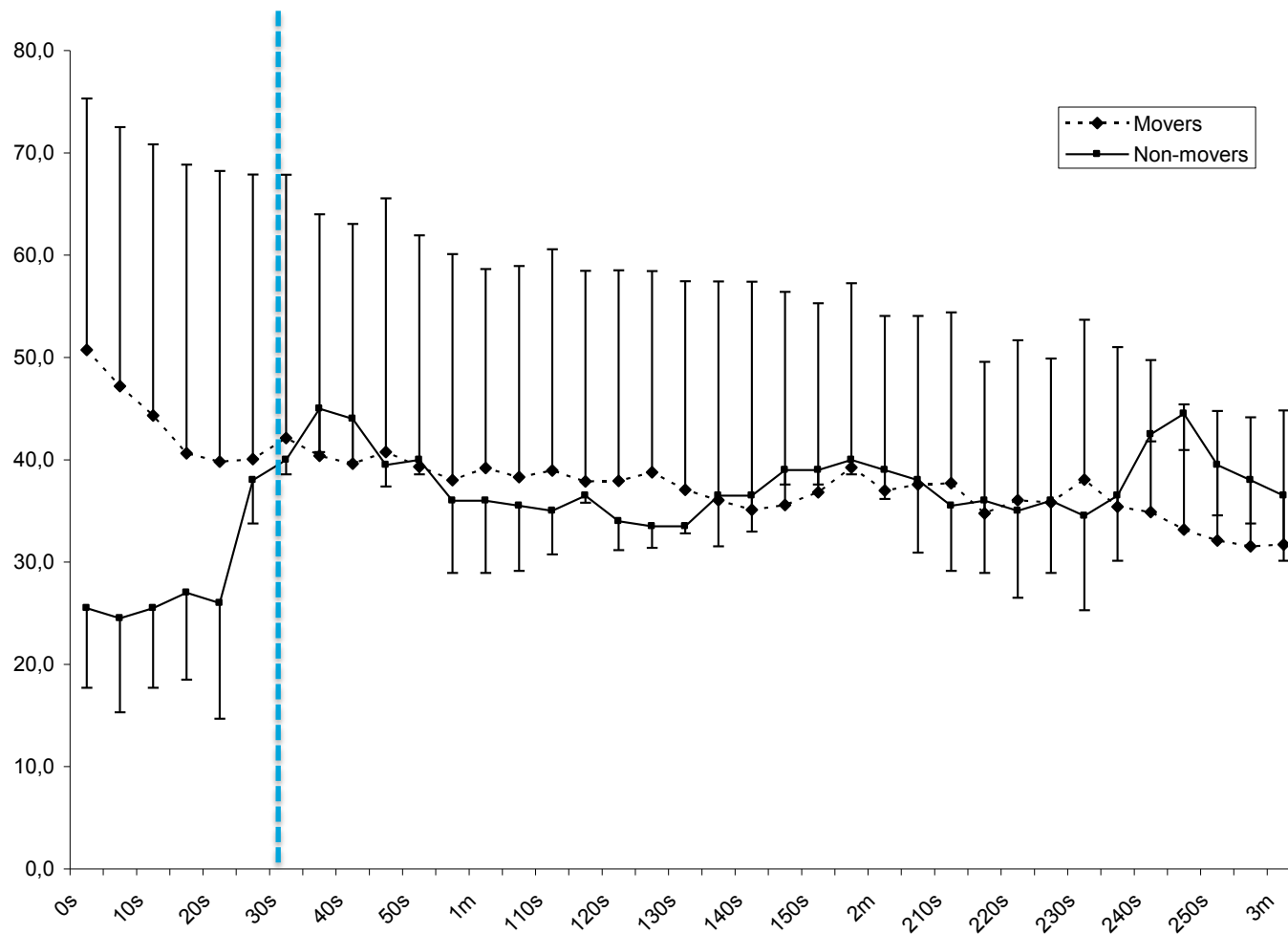
SPI normalizado 1º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



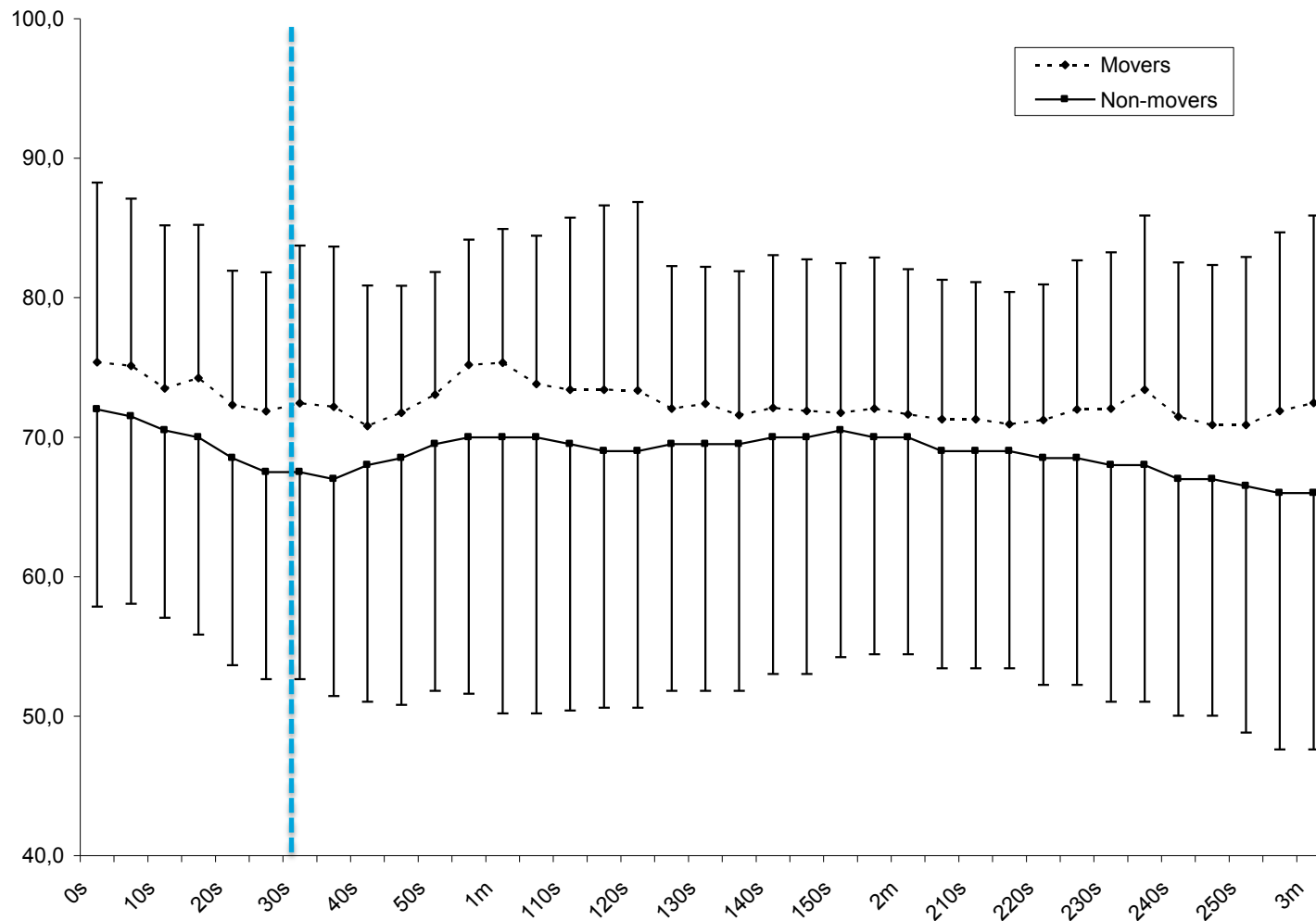
SE 1º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



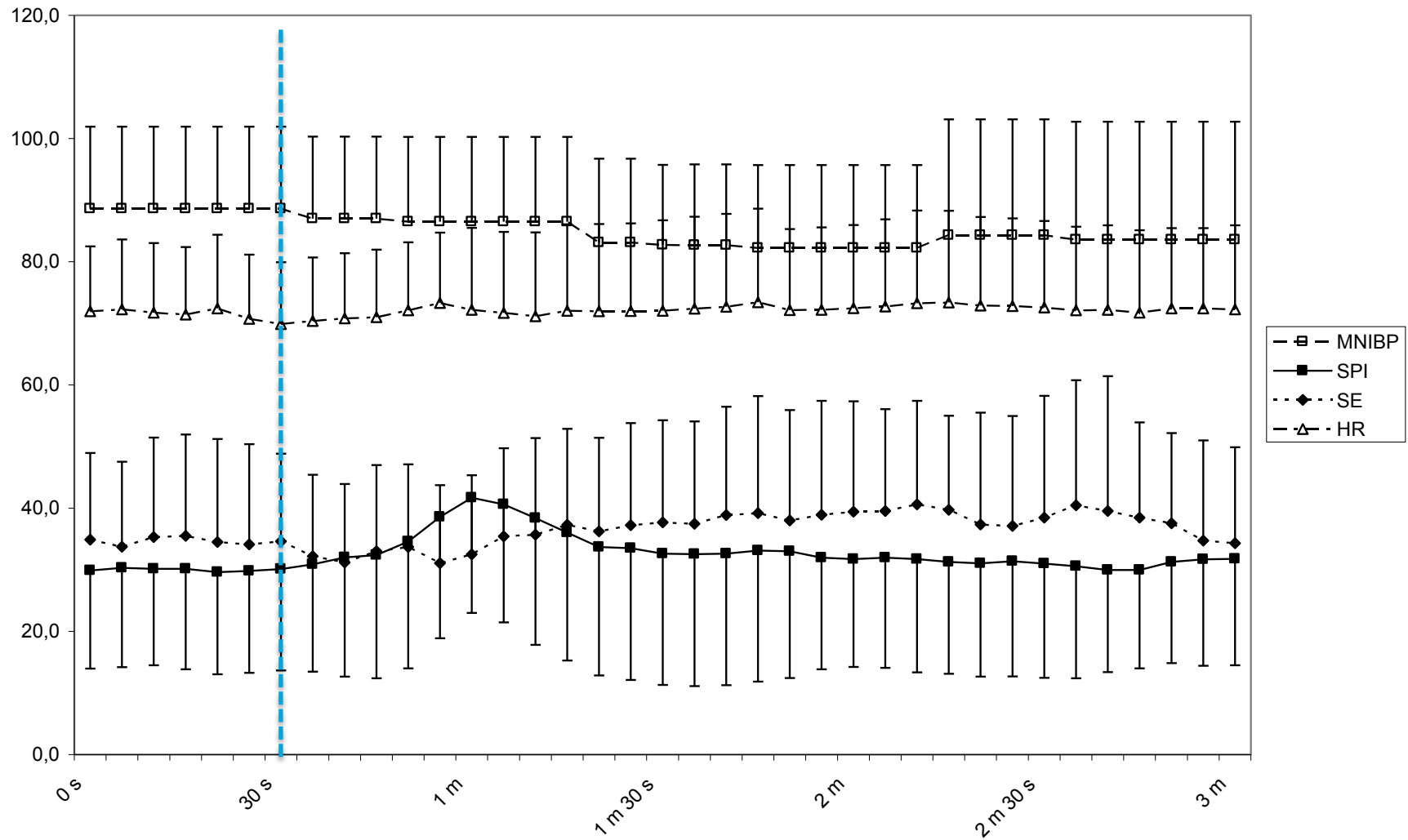
HR 1º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



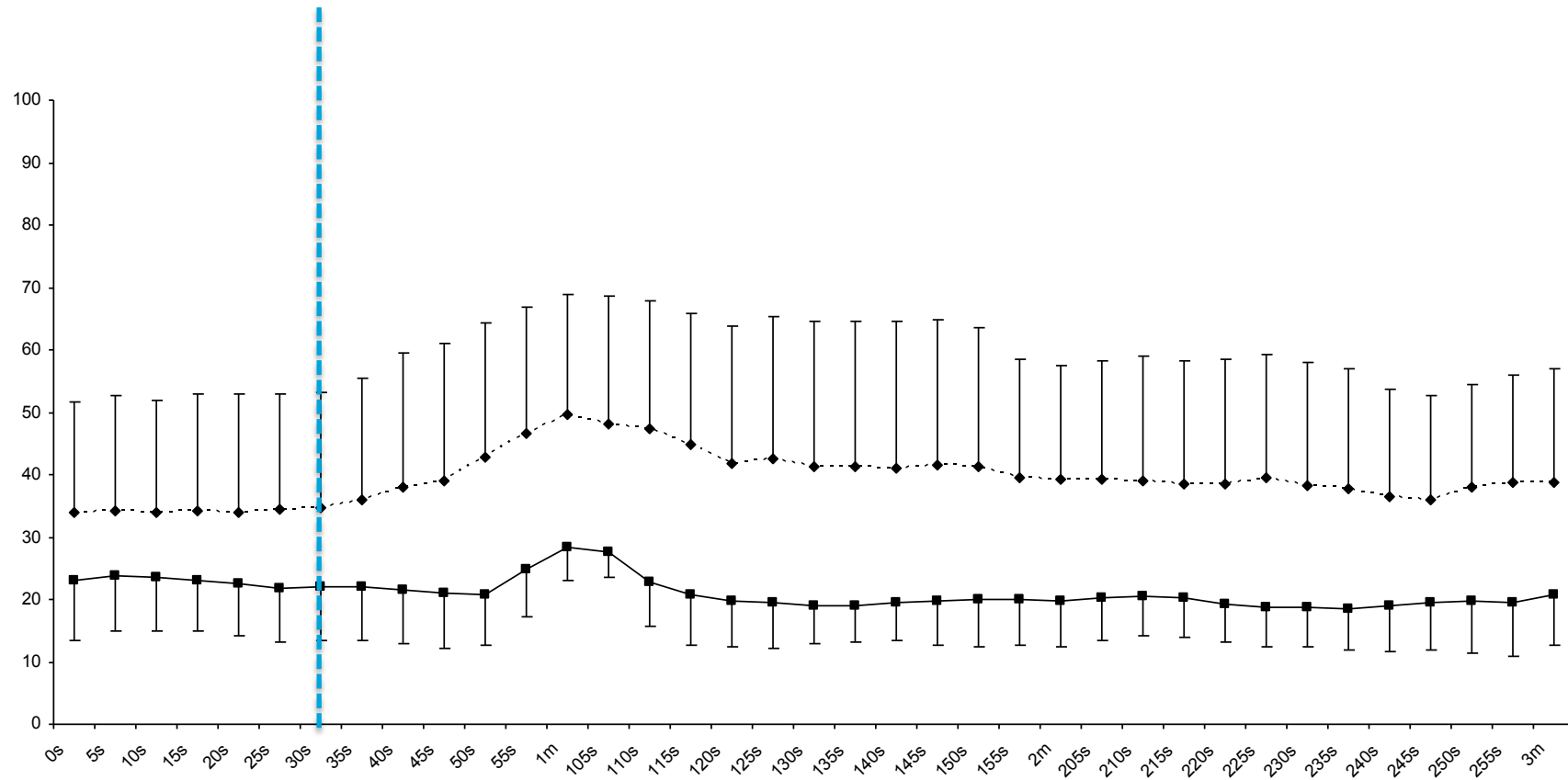
2º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



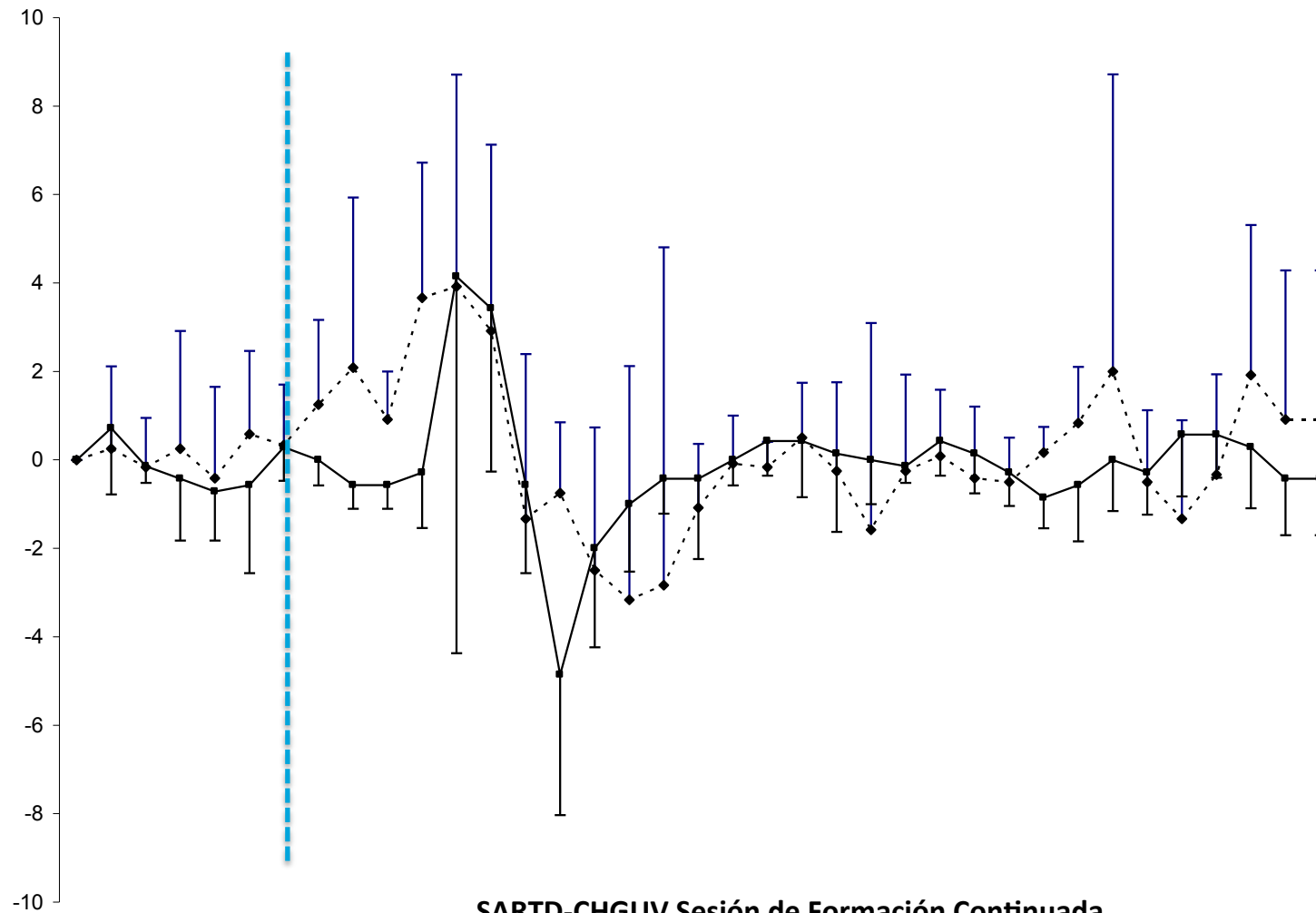
SPI 2º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



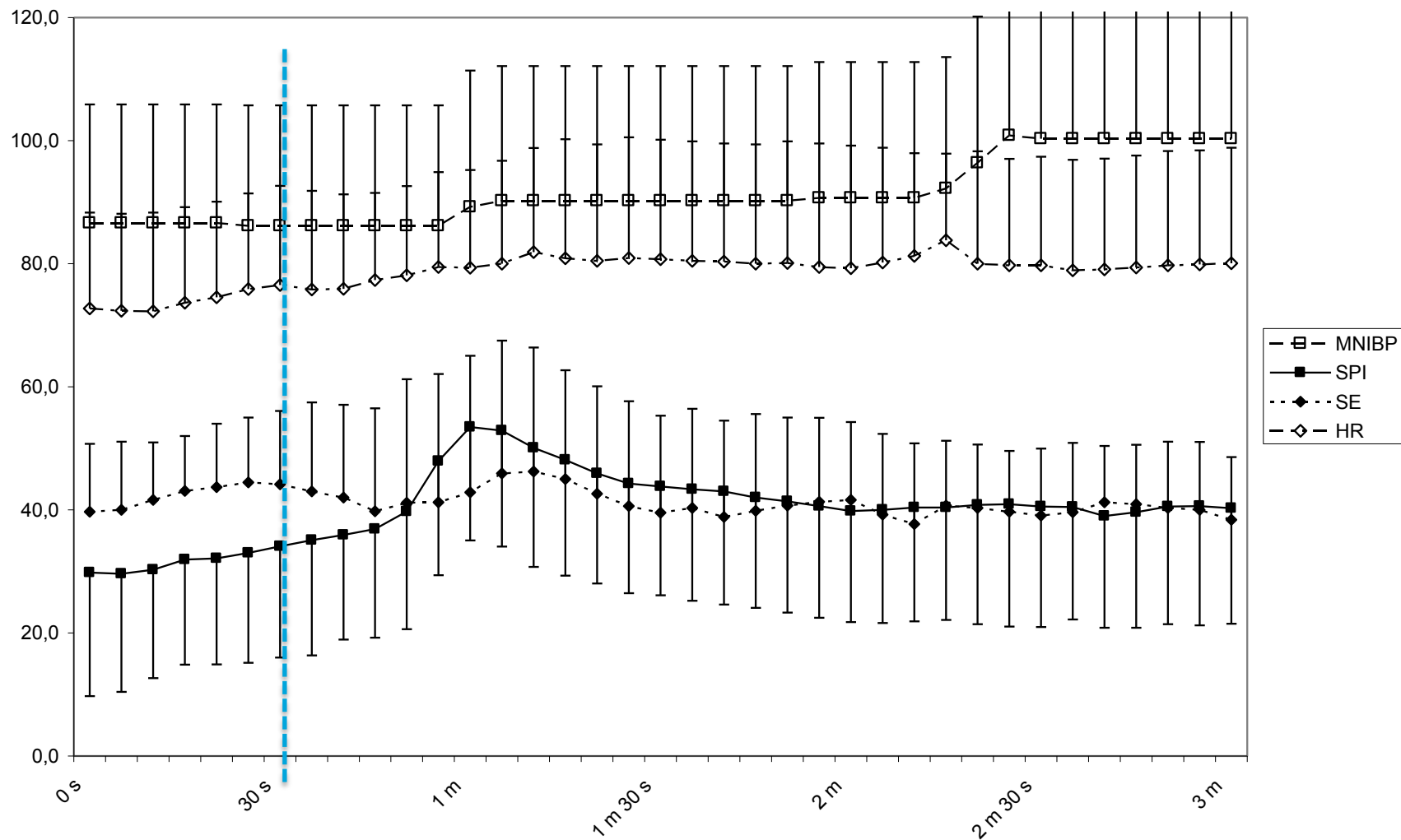
SPI normalizado 2º estímulo



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



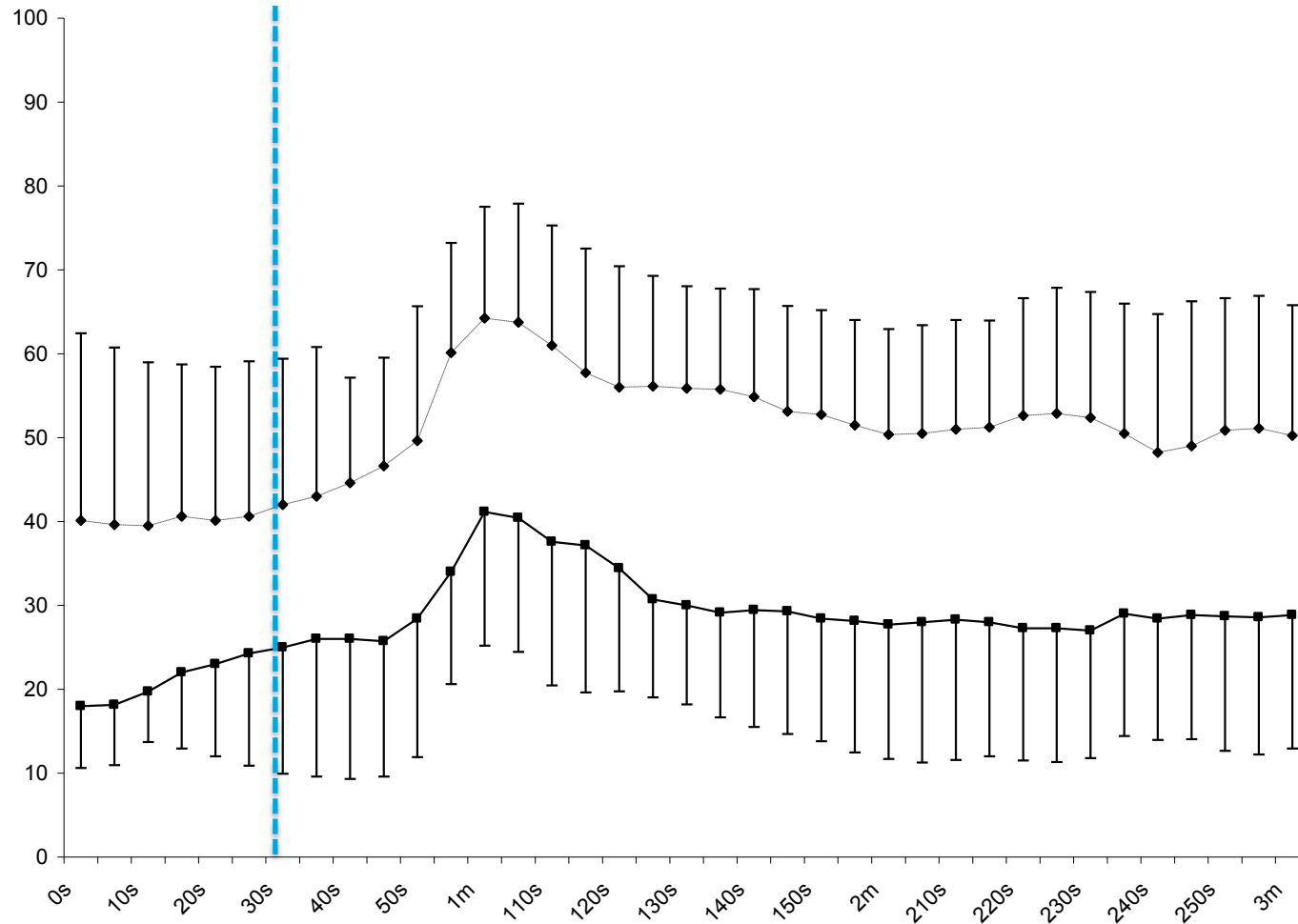
Laringoscopia



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



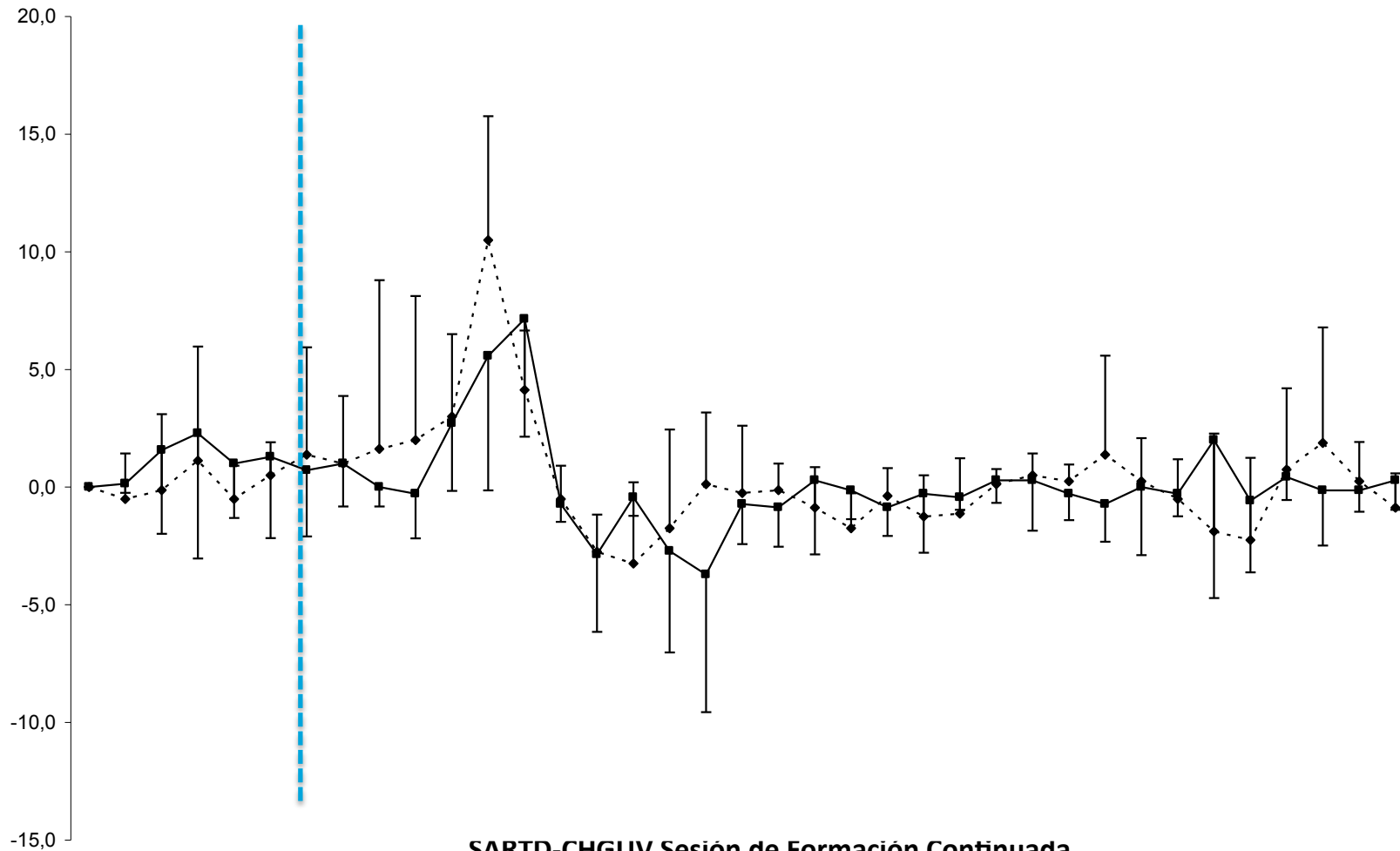
SPI Laringoscopia



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



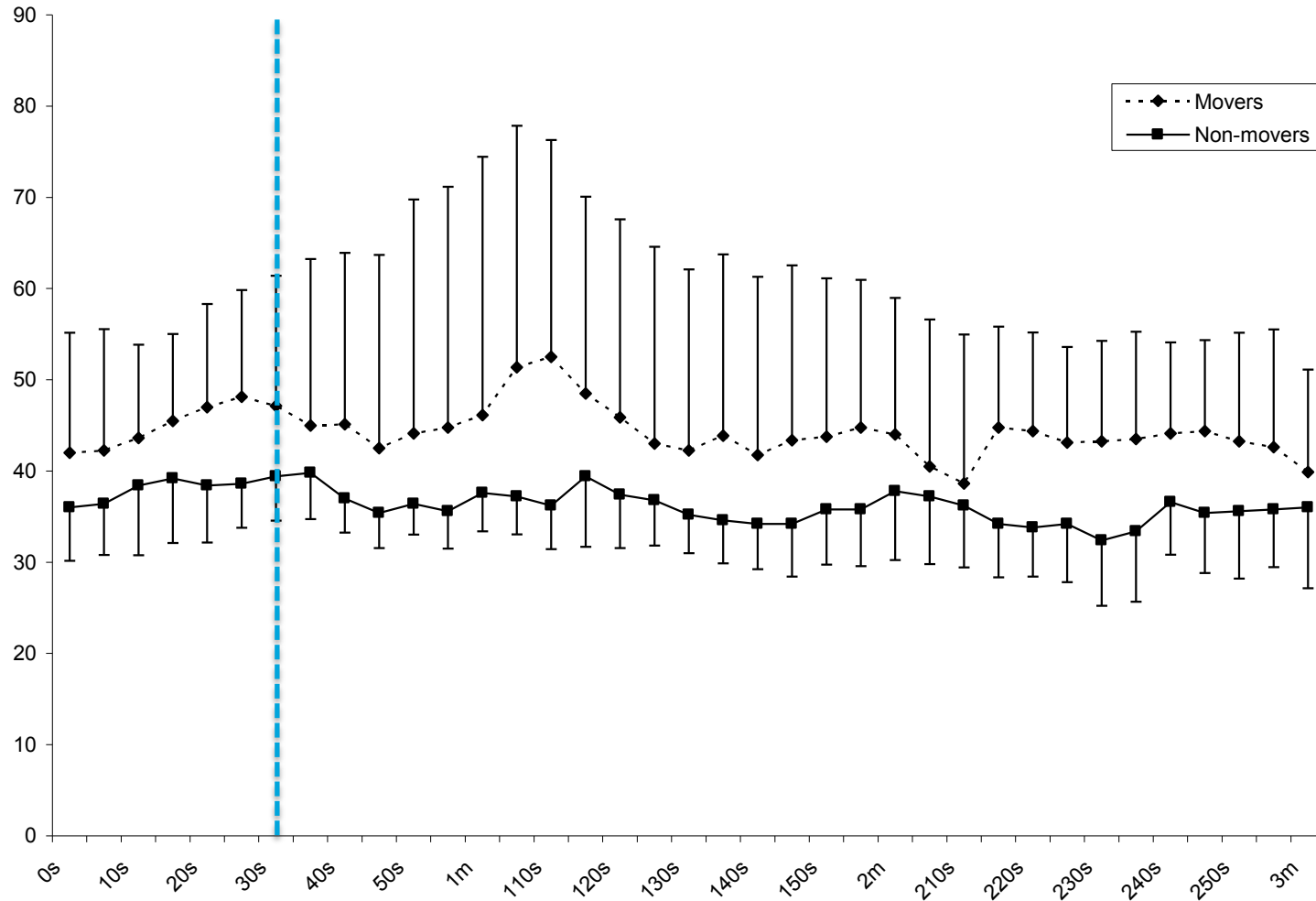
SPI normalizado Laringoscopia



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



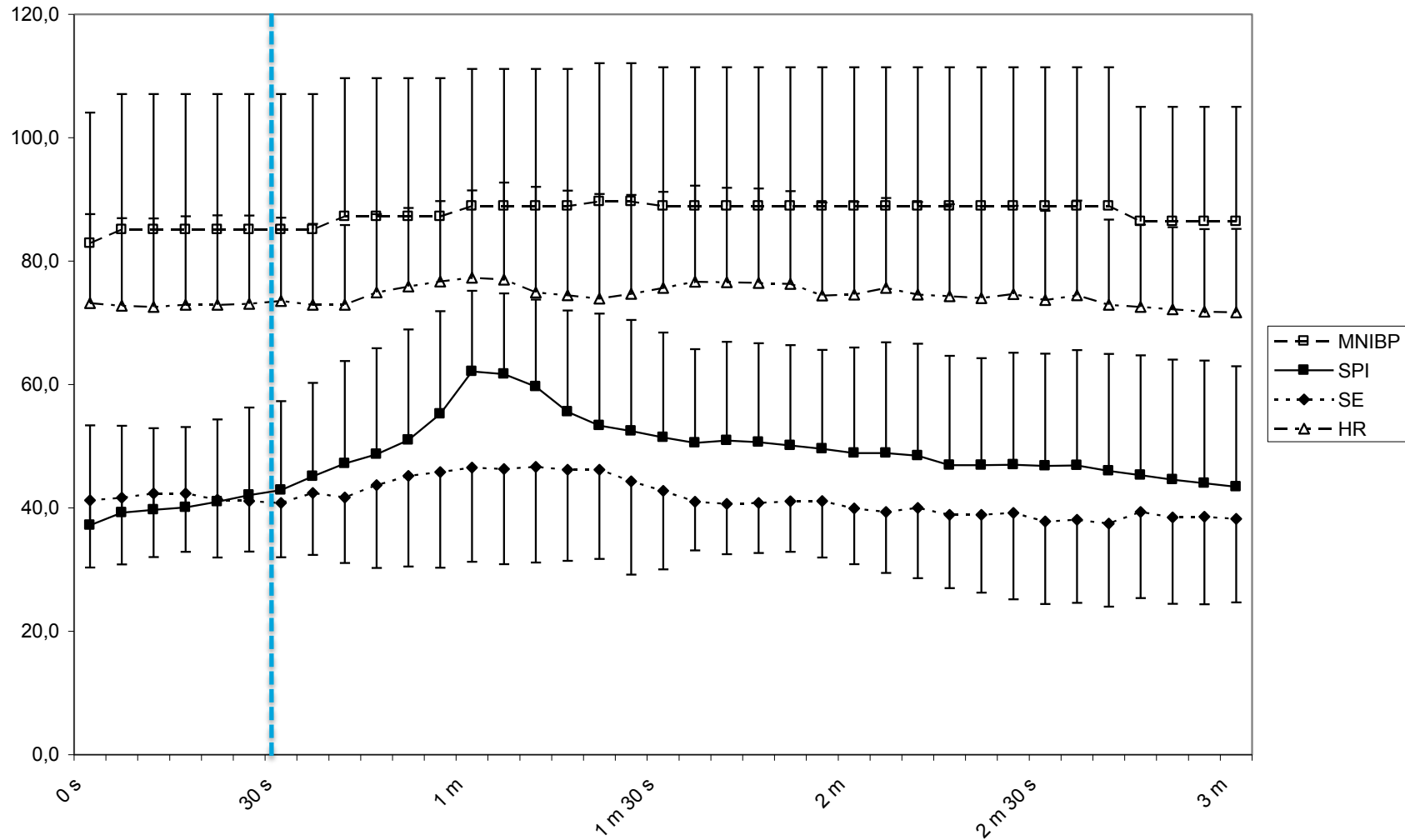
SE Laringoscopia



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



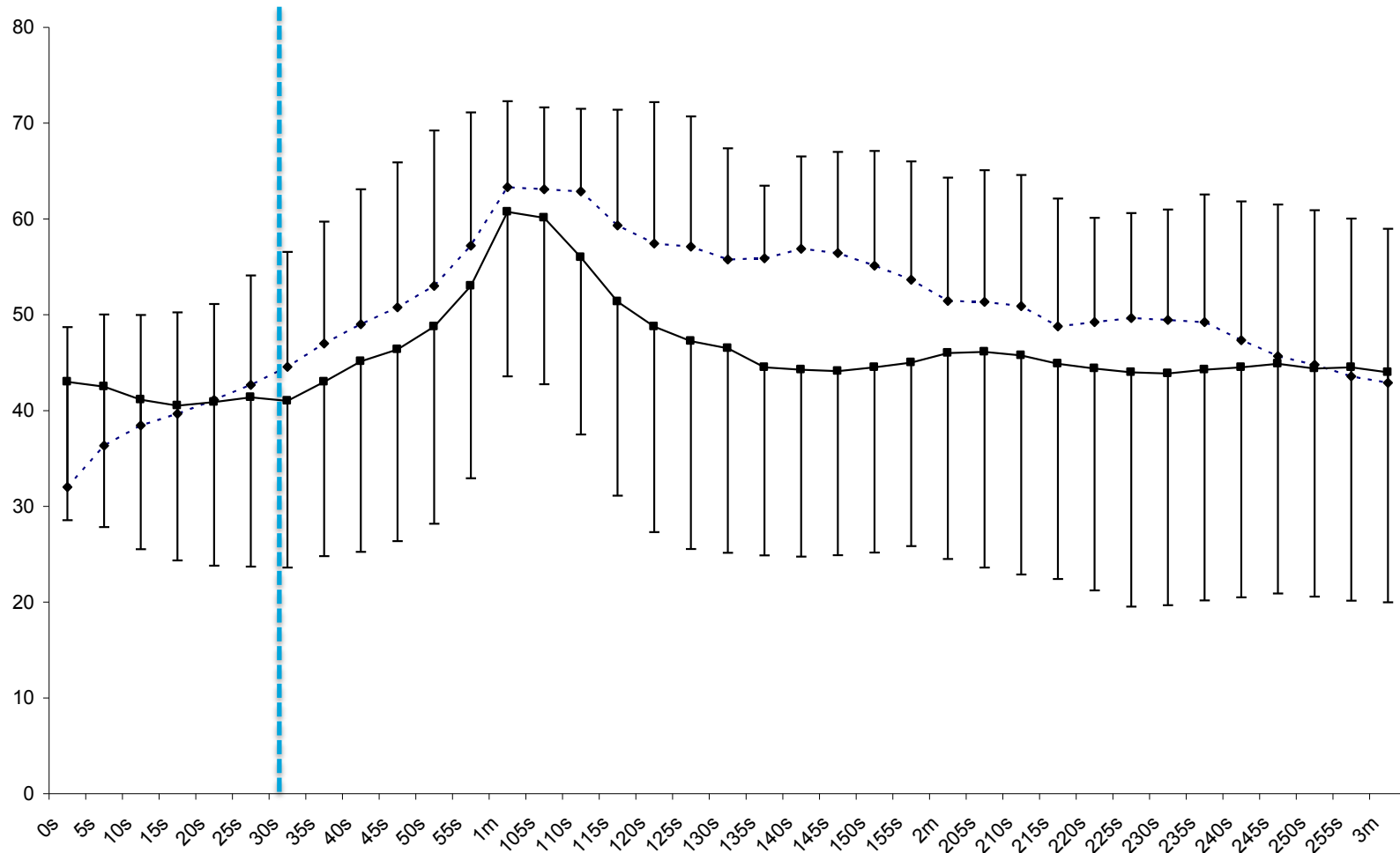
Incisión quirúrgica



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



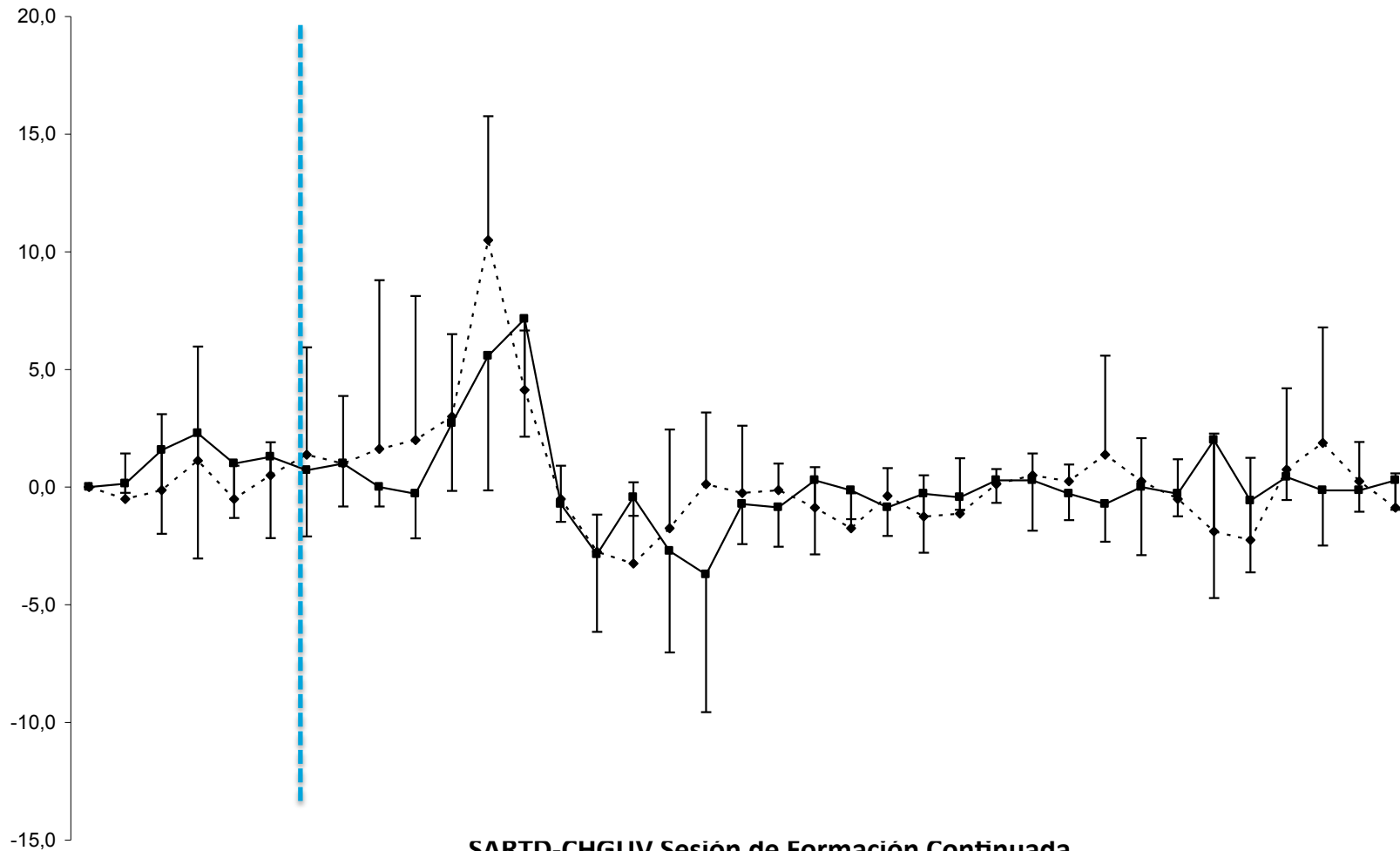
SPI Incisión quirúrgica



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



SPI normalizado Incisión quirúrgica



SARTD-CHGUV Sesión de Formación Continua
Valencia 4 de Octubre de 2011



SPI (ASA 2011, Chicago): Conclusiones

SPI reacts to nociceptive stimuli during general anaesthesia.

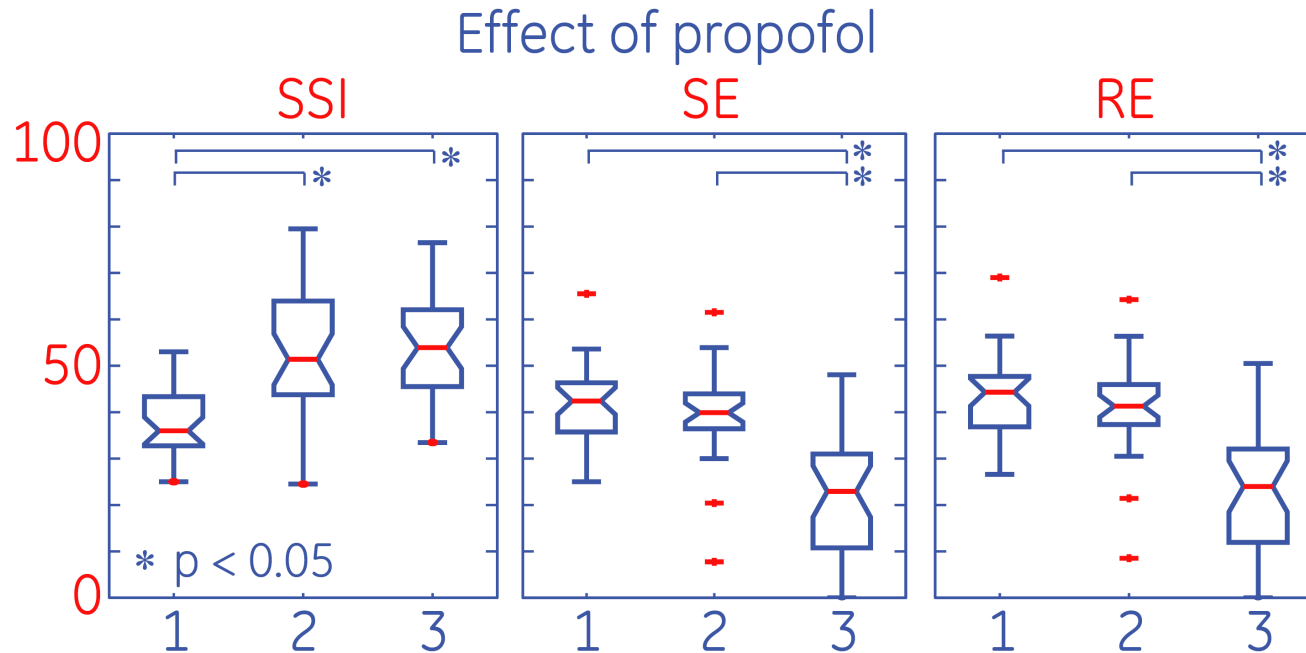
Moreover, SPI values increased regardless of nociceptive stimulation causes a motor response or not.

It is possible that SPI may reflect nociception induced by a nociceptive stimulus of any intensity, and that beyond a certain SPI threshold value it can also predict motor response.



Estudios para evaluar SPI con:

- Propofol (Uutela et al.)

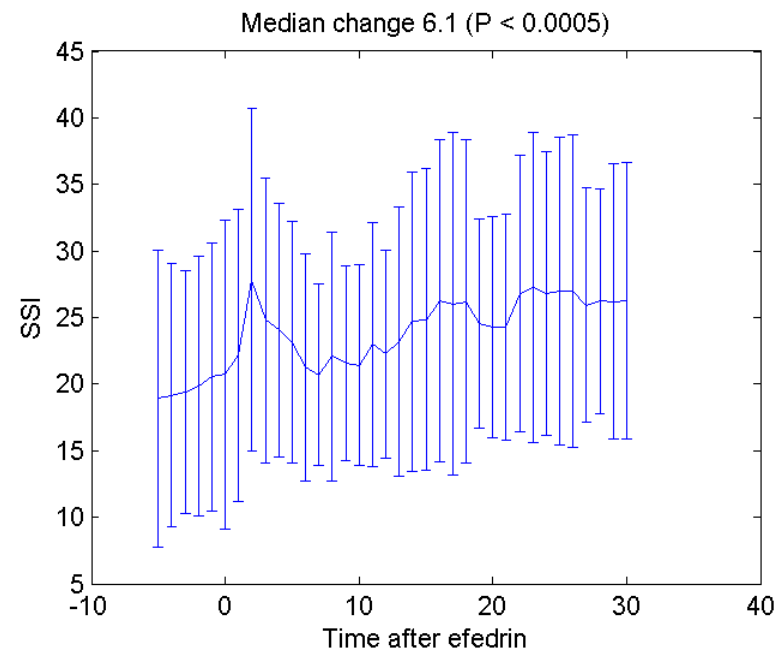
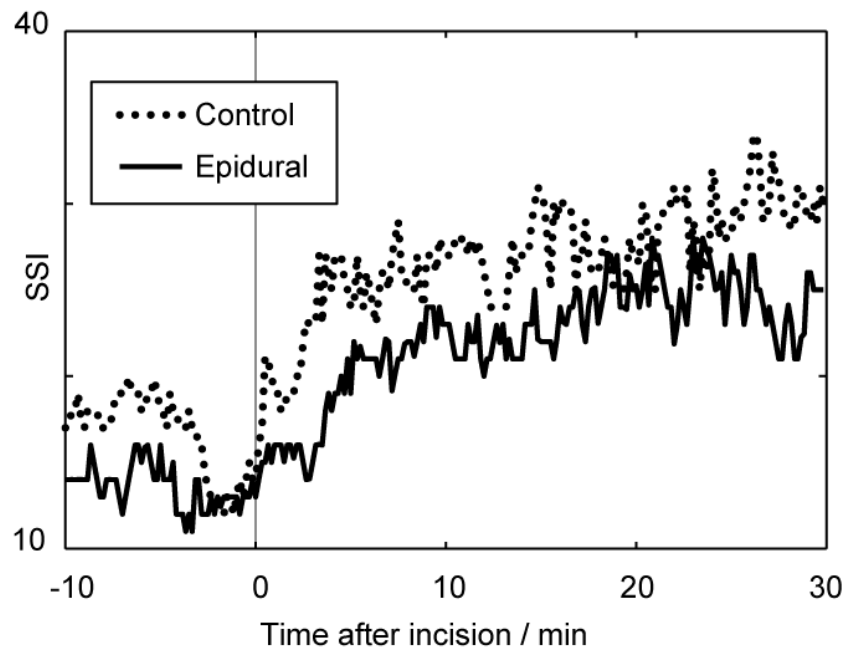


1 = Before incision
2 = Propofol Ce 3 µg/ml
3 = Propofol Ce 6 µg/ml



Estudios para evaluar SPI con:

- Bloqueo epidural (Rantanen et al)



Does SPI work in/with...?

- hypothermia? down to 35 °C at least, **yes**
- massive bleeding? **not** after loosing finger PPG
- cardiac surgery? **not** during bypass
- atrial fibrillation / other rhythm disturbances?
better than expected, as long as the rhythm maintains circulation
- vasoactive medication?
 - atropine: **no**
 - ephedrine: **yes** (temporary problems, though)
- awake patients postoperatively?
 - **not validated**, not designed for awake patients
- awake patients with chronic pain?
 - **not validated**, not designed for those patients

Summary: Surgical Pleth Index

Utilizes readily available physiological signals

Reactive to noxious incidents during surgery

Sensitive to analgesic drug concentrations

Non-sensitive to changing hypnotic drug concentrations

May help to titrate anti-nociceptive medication

Concepts and correlations relevant to general anaesthesia

B. W. Urban* and M. Bleckwenn

What did speakers at MAC2001 think about anaesthesia consisting of immobility, analgesia, unconsciousness and ‘not harming the patient’? Of these four components Eger, the originator¹⁵ of the minimum alveolar concentration (MAC) concept now considered as essential for general anaesthesia, only amnesia and immobility, while originally he¹⁴ had included analgesia as an essential property of anaesthesia.

Antognini⁴ and Heinke²⁴ define general anaesthesia as the presence of unconsciousness, amnesia and immobility (in response to noxious stimulation); Antognini explicitly excludes analgesia and lack of haemodynamic responses as an absolute requirement. He reasons that pain is the conscious awareness of a noxious stimulus; therefore, if anaesthetized patients are unconscious, they cannot perceive pain.

SARTD-CHGUV Sesión de Formación Continuada
Valencia 4 de Octubre de 2011

