Surgical Pleth Index and Analgesia Nociception Index for intraoperative analgesia in patients undergoing neurosurgical spinal procedures, a comparative study

Dostalova V, Schreiberova J, Dopitova P, Dostal P

Dept. of Anaesthesiology and Intensive Care Medicine,
Charles University, Faculty of Medicine Hradec Kralove, University Hospital Hradec Kralove,
Czech Republic

Background and Goal of the Study

The Surgical Pleth Index (SPI) and the Analgesia Nociception Index (ANI) have been recently suggested for the non-invasive intraoperative monitoring of nociception/anti-nociception balance¹. The goal of this study was to compare intraoperative use of opioids guided either by ANI, SPI or anaesthesiologist's judgment during desflurane-sufentanil anaesthesia respectively.

Material and Methods

72 adult ASA I – III patients scheduled for elective neurosurgical spinal procedures were randomized into the ANI group, SPI group and control group. Exclusion criteria included presence of non-sinus rhythm, pacemaker, planned postoperative ventilation, procedures with planned awake intervals, chronic pain with opioid medication, opioid addiction, epidural administration of local anaesthetic in combination with opioid, hormonal contraceptives. Anaesthesia and intraoperative use of opioids (sufentanil boluses based on body weight) were managed according to a strict protocol. The use of sufentanil was targeted to keep ANI value within the range of 50 – 70 in the ANI group and SPI value below individual post-induction baseline SPI value plus 10 points in the SPI group. In the control group, the use of opioids was left at anaesthesiologist's discretion. Results are expressed as mean ± SD or as the median with interquartile ranges (IQR) based on the results of a test of normality of the distribution using a one-sample Kolmogorov-Smirnov test. Intergroup differences were tested using ANOVA with a Student-Newman-Keuls test for all pair wise comparisons, a Kruskal Wallis test or a Chi-squared test, as appropriate.

Results

There were no differences in patient's baseline characteristics, duration and type of surgery, duration of anaesthesia, used concentrations of desflurane and total sufentanil dose (Table 1, Table 2). Additional sufentanil boluses were administered earlier in the ANI and SPI groups in comparison with the control group (3rd dose after 51.8 ± 22.1 vs 52.7 ± 14.8 vs 84.5 ± 24.8 min respectively, p = 0.001; 4th dose after 61.3 ± 30.1 vs 57.2 ± 14.1 vs 120.0 ± 26.2 min, p = 0.003, and 5th dose after 78.8 ± 33.7 vs 74.0 ± 11.6 vs 146.7 ± 23.2 min respectively, p = 0.009), Figure 1. There were no differences in time to spontaneous breathing at the end of anaesthesia (6.2 ± 5.4 vs 4.4 ± 3.2 vs 4.3 ± 2.6 min respectively, p = 0.207), postoperative pain scores, cortisol serum concentrations and complication rates between groups (Table 3).

Discussion

Our study had several limitations. Anaesthesia protocol could have influenced obtained results. Number of patients was limited and imbalances between groups, although statistically non-significant, could also have influenced obtained data.

Conclusion

Within limitations of this study, our findings suggest that both SPI and ANI monitoring provide clinically usable intraoperative sufentanil use guidance and significantly modify timing of sufentanil boluses in comparison with anaesthesiologist's guided intraoperative analgesia.

References

1. Gruenewald M et al. Minerva Anesthesiol. 2015; 81(5): 480-9.

Table 1. Patients' characteristics.

	ANI group (n = 24)	SPI group (n = 24)	Control group (n = 24)	P-value
Age	49.6 ± 16.9	58.8 ± 12.5	54.5 ± 14.5	0.098
Gender (M/F), N/N	13/11	15/9	8/16	0.1146
Weight (kg)	85.8 ± 15.5	78.0 ± 15.5	77.7 ± 15.5	0.133
Height (cm)	175 ± 11	170 ± 9	170 ± 10	0.177
BMI	28.3 ± 4.5	26.8 ± 4.6	26.7 ± 3.9	0.397
ASA physical status I/II/III, N	3/18/3	2/19/3	1/20/3	0.9359
NSAID preoperative use, N	4	6	10	0.226
Alcohol abuse, N	1	2	0	0.168
Cigarette smoking, N	7	7	7	1.0000
Type of surgery, N				
Laminectomy	8	12	10	0.5037
Decompression of a narrow spinal canal	5	4	5	0.9151
Stabilization	7	5	7	0.7513
Fracture stabilization	2	2	0	0.3469
Other	2	1	2	0.8066

ASA, American Society of Anesthesiology; BMI, body mass index; M, male; F, female; SD, standard deviation; VAS, visual analog score, N, number of patients; NSAID, non-steroid antiinflammatory drug

Table 2. Perioperative data for duration of anaesthesia, sufentanil dose and desflurane concentration.

	ANI group (n = 24)	SPI group (n = 24)	Control group (n = 24)	P-value
Duration of anaesthesia (min)	120.0 (86.0; 146.0)	82.0 (73.0; 117.0)	94.0 (66.0; 125)	0.230
Total sufentanil dose (µg)	40.0 (30.0; 65.0)	30.0 (20.0; 45.0)	30.0 (20.0; 45.0)	0.2253
Sufentanil dose per kg/h (µg)	0.236 (0.167; 0.386)	0.318 (0.167; 0.392)	0.256 (0.190; 0.320)	0.5687
Desflurane (vol %)	4.9 ± 0.7	4.6 ± 0.5	4.7 ± 0.6	0.230

Figure 1. Timing of intraoperative sufentanil boluses

Table 3. Postoperative pain scores, serum cortisol concentrations and postoperative complication rates

	ANI group (n = 24)	SPI group (n = 24)	Control group (n = 24)	P-value
Postoperative serum cortisol (nmol/l)	251 (124; 415)	324 (226; 564)	268 (193; 406)	0.4914
Mean VAS 1 st day	1.06 ± 0.57	0.83 ± 0.31	1.10 ± 0.36	0.0659
Length of postoperative opioid use, days	1.00 (1.00; 2.00)	1.00 (1.00; 1.00)	2.00 (1.00; 2.00)	0.0664
Postoperative complications (N)	3	1	1	0.4233

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