Detection of noxious stimuli during general anesthesia using the NoL™ index for nociception level

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Background and Goal of Study

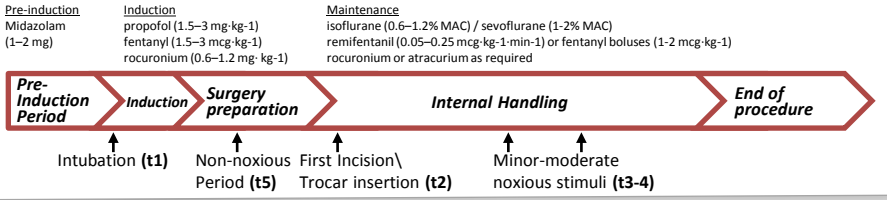
A novel multi parametric index for the assessment of Nociception Level (NoL) during general anesthesia (GA) was recently presented [1]. The NoL index (0-100) is derived by a non-linear combination of several pain-related physiological parameters: heart rate (HR), high frequencies of heart rate variability (HRV-HF), plethysmograph wave amplitude (PA), skin conductance level (SCL) and number of fluctuations (NSCF), together with the time derivatives of those parameters.

In the previous study [1], the NoL was based on signals acquired using the commercial off-the-shelf MP 100 system (BioPac System Inc., Goleta, CA, USA). In this study, data was acquired using the PMD-100™ finger probe (Medasense Biometrics ltd, Ramat Yishai, Israel), that constitutes plethysmograph (PPG), skin conductance (SC), skin temperature and 3-axis accelerometer.

The objective was to investigate the ability of the NoL index to detect noxious stimuli of different intensities during GA.

Material and Methods

25 ASA I-II patients scheduled for elective surgery under GA were prospectively enrolled. Anesthesia protocol was applied as accepted at the study site. Patients´ PPG and skin conductance were acquired using the PMD-100™ finger probe. The physiological parameters HR, PA, HRV and SCL were extracted and compared to the NoL index. Five events across the surgery were examined (t1-5). The changes (Δ) in parameter values following events t1-5 were investigated using the Wilcoxon rank test and the parameter correlation to stimuli severity was obtained using the Spearman Rho coefficient. The following figure presents the time course of the study (timeline, medication and investigated events).



Results

Table 1 presents deltas in parameter values 2min before and 1min after t1-5. NoL increased significantly during all noxious stimuli (t1–4) as opposed to the individual parameters. ΔNoL increased significantly with growing stimuli severity (ρ=0.78; $p<0.05$; *Spearman Rho*), indicating the ability of NoL to grade different levels of nociception.

Parameter Response

*$p<0.05$; **$p<0.01$;***$p<0.001$ - Wilcoxon rank test

Clinical events		ΔNoL mean (se)	ΔHR [min⁻¹] mean(se)	ΔPA [normalized] mean(se)	ΔHRV-HF [normalized] mean(se)	ΔSCL [normalized] mean(se)
Spearman Rho		ρ=0.78; p<0.005	ρ=0.44; p<0.005	ρ=-0.27; p<0.005	ρ=-0.25; p=0.09	ρ=0.26; p<0.005
t1	intubation	20.2(3.7)***	10.5(2)***	-0.69(0.2)**	-0.4(0.19)*	0.2(1)
t2	First incision \ Trocar insertion	19.0(3.1)***	9.3(2.4)**	-0.42(0.13)*	-0.35(0.22)	0.14(0.2)
t3	Moderate noxious stimuli	11.8(4.3)**	6.1(1.6)	-0.20(0.1)*	-0.22(0.25)	-0.2(0.19)
t4	Minor noxious stimuli	8.6(2.8)**	1.9(1.1)	0.01(0.13)	-0.7(0.2)*	-0.17(0.14)
t5	Non-noxious period	-5.0(1.8)	0.05(0.06)	-0.08(0.08)	0.21(0.22)	0.01(0.04)

Conclusions

The NoL index better detected and graded noxious stimuli of different intensities compared to individual parameters commonly used for the assessment of nociception. The proposed NoL may potentially be implemented as a clinical tool for pain assessment during GA. Further studies are needed to validate these results.

Literature

[1] Edry R et al. Proc. of ASA Ann meeting,Oct 2010