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Impact d'un programme éducatif hybride pour le monitoring de l'adéquation de l'anesthésie (AoA) et les complications postopératoires : une étude prospective avant-après de type " quality improvment "

Pierre Lancelot

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UNIVERSITE DE MONTPELLIER
FACULTE DE MEDECINE MONTPELLIER-NIMES

THESE

Pour obtenir le titre de
DOCTEUR EN MEDECINE

Présentée et soutenue publiquement
Par
Pierre LANCELOT

le 17/10/2025

**Impact d'un programme éducatif hybride pour le monitoring
de l'adéquation de l'anesthésie (AoA) et les complications
postopératoires: une étude prospective avant-après de type
« quality improvment »**

Directeur de thèse :
Pr Philippe Cuvillon

JURY

Président :

- Pr CAPDEVILA Xavier

Assesseurs :

- Pr CUVILLON Philippe (directeur de thèse)
- Dr GRICOURT Yann
- Dr BOISSON Christophe

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**Impact of a hybrid educational program for
Adequacy-of-anesthesia monitoring on post-operative
outcomes: a prospective before-after quality improvement
study**

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Abréviations, glossaire

- **AoA**: Adequacy of Anesthesia
- **AKI**: Acute Kidney Injury
- **AMI** : Acute Myocardial Infarction
- **AAGA**: Accidental Awareness during General Anesthesia
- **BIS**: Bispectral Index
- **CKD**: Chronic Kidney Disease
- **CRNA**: Certified Registered Nurse Anesthetist
- **DOA**: Depth of Anesthesia
- **ERAS**: Enhanced Recovery After Surgery
- **IOH**: Intraoperative Hypotension
- **IRB**: Institutional Review Board
- **KDIGO**: Kidney Disease: Improving Global Outcomes
- **LPV**: Lung-Protective Ventilation
- **MAP**: Mean Arterial Pressure
- **NMT**: Neuromuscular Transmission
- **NOL**: Nociception Level Index
- **ICU**: Intensive Care Unit
- **PACU**: Post-Anesthesia Care Unit
- **PONV**: Postoperative Nausea and Vomiting
- **SE**: State Entropy
- **SPI**: Surgical Pleth Index
- **LOS** : Length Of Stay
- **ICU** : Intensive Care Unit
- **NRS** : Numerical Rating Scale

Introduction

Advanced monitoring devices for depth of anesthesia (DOA) and nociception have gained popularity in recent years, with the aim of personalizing care and improving postoperative outcomes (1). To date, DOA monitors such as State Entropy (SE) or Bispectral Index (BIS) have shown **conflicting results** on postoperative cognitive dysfunction (2,3) and one-year mortality (4). Nociceptive monitors such as the Surgical Pleth Index (SPI), Nociception Level Index (NOL) or pupillometry have failed to consistently reduce intraoperative opioid administration compared to standard care (5,6). Consequently, their integration into daily practice is not yet advocated by current guidelines, except for the prevention of accidental awareness during general anesthesia (AAGA) with DOA (7). The combined impact of DOA and nociception monitoring on postoperative complications and adverse events remains poorly investigated (8). Postoperative complications occur in approximately 10–20% of intermediate and high-risk surgeries and remain a major concern for healthcare providers. By contributing to increased mortality (9), prolonged hospital stays (9), reduced quality of life (10), and lower patient satisfaction (11), these complications ultimately lead to higher healthcare costs (12).

The limited clinical impact of DOA and nociception monitoring previously reported may be partially explained by the lack of structured educational programs specifically targeting appropriate ranges (2,3,4,8). Implementing these monitors in the operating room remains challenging, as it disrupts established anesthesia practices based on Minimum Alveolar Concentration (MAC), pharmacologic reasoning, or clinical intuition. Their effective use requires not only technical training but also confidence, parameter awareness, and integration into clinical decision-making especially for clinicians not familiar with their use. A recent international survey identified insufficient training and the absence of standardized decision-making algorithms as key barriers to daily implementation (13). Consequently, addressing these challenges requires a dedicated quality improvement program (14).

This quality improvement initiative aimed to evaluate the impact of a hybrid educational program on intraoperative SE and SPI monitoring compliance and its association with major postoperative complications in non-cardiac surgery. We hypothesized that this program may reduce the postoperative

morbidity and mortality at 28 days (POD28) following the training session.

Methods

Ethics , design , guidelines

This study was approved by the Sud Méditerranée III Ethics Committee Institutional Review Board (IRB 2023-A01401-44) and registered on ClinicalTrials.gov (NCT06111248). Due to the nature of the study, and according to the French law, the requirement for written informed consent was waived nonetheless. The study followed the Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) guidelines for the reporting of quality improvement data (15).

This was a quasi-experimental, prospective before-and-after study, conducted at a tertiary hospital (Nîmes, France). The study included three sequential phases: a 'before' phase in which anesthesia providers followed their usual practices (standard care); a one-month training phase (washout period); and an 'after' phase during which providers could apply the new practices. All anesthesia staff from the Department of Anesthesiology and Perioperative Medicine were invited to voluntarily participate in the study. In this institution, anesthesia is typically delivered by a team composed of one attending anesthesiologist and one CRNA, with possible support from residents or CRNA students. Before launching the study, all providers were informed that an automatic remote data collection system, Carestation™ Insights (GE Healthcare, USA), would be connected to selected anesthesia workstations in the operating rooms to record all cases anonymously.

The intervention

Designing the intervention

From February 1 to April 1, 2024, a team of four on-site anesthesiologists developed the AoA (Adequacy of Anesthesia) training program. AoA was defined as compliant with target ranges during general anesthesia maintenance for the following three parameters: State Entropy (SE) between 40 and 60, Surgical Pleth Index (SPI) between 20 and 50, and Neuromuscular Transmission (NMT) >90% before extubation when neuromuscular blockers were used.

This hybrid training program was designed based on identified local needs, operating room organizational constraints and published guidelines. The training was structured as follows:

- Theoretical module: A one-hour in-person lecture (66 slides) for medical and paramedical staff, with an on-demand audio-commented online version. Fishbone diagram (**Figure 1**) summarizes the potential barriers to the use of SPI and SE monitoring in our institution prior to the study.

- Practical module: 30-minute bedside sessions were conducted during ongoing surgical procedures, with trainers providing hands-on guidance on device setup, data interpretation, and parameter adjustment.

- Training evaluation: based on pre and post-tests, using a 10 items anonymous multiple choice questionnaire covering the benefits, target ranges, and interpretation limits of SPI, SE and NMT. The post-test included 11 additional Likert-scale questions on confidence, perceived proficiency, and training satisfaction.

The objective of the intervention was to promote compliance with predefined AoA targets during general anesthesia in moderate to high risk surgical patients. Consequently, all anesthesia providers were encouraged to monitor and adjust SPI, SE and NMT in real time to achieve compliance. These monitoring tools were already integrated into all anesthesia workstations prior to the study. Additionally, the Balance View decision support interface, which displays real-time SPI and SE trends, was available on workstation screens to help providers decide whether to adjust nociception or narcosis. All monitoring devices were CE-marked and used according to their approved indications. To minimize the Hawthorne effect, data from the 'before' phase were not disclosed to participants throughout the study period.

Implementing the intervention

All anesthesia providers were encouraged to voluntarily participate in the one month training period. Training sessions were conducted on-site during working hours, without CME accreditation or required examination. To enhance participation, communication began two weeks prior to the training via professional email and posters displayed in the operating rooms, including a QR code linking to a digital explanatory booklet accessible at any time. No incentives were offered to reinforce participation. The

pre-test was completed 15 days prior to the start of training, and the post test was administered one month later.

Although trainers remained available after the training month, anesthesia providers were not actively encouraged to apply the new practices. Specifically, no pop-up alerts were integrated into the Anesthesia Information Management System in case of non-compliance with intraoperative AoA targets, and no feedback on compliance trends was shared with the anesthesia team. However, providers could request access to their intraoperative data to review their performance.

Standard intraoperative cares

Regardless of the study stage, a lung-protective ventilation strategy (tidal volume 6–8 mL·kg⁻¹ predicted body weight, PEEP, and recruitment maneuvers) was applied using the Aysis CS² ventilator (GE Healthcare, Madison, WI, USA). Induction, anesthesia maintenance, as well as the use of regional anesthesia, were left to the anesthesia team discretion. Hemodynamic management followed local practices, with norepinephrine infusions administered to maintain a mean arterial pressure (MAP) >60 mmHg.

Antibiotic prophylaxis was administered according to the updated French guidelines (www.SFAR.org). The postoperative multimodal analgesia plan included intravenous (IV) paracetamol and IV ketoprofen, unless contraindicated. PONV (post operative nausea and vomiting) prophylaxis was administered based on risk assessment using the Apfel score. Postoperative care plans were determined preoperatively but could be adjusted based on intraoperative events. Lastly, the same surgeons participated throughout the study period to ensure consistency.

Population

To evaluate the impact of the AoA training intervention, all consecutive adult inpatients (≥18 years) with ASA physical status II–IV undergoing noncardiac intermediate- to high-risk surgery under general anesthesia of at least one hour were included (16). Exclusion criteria were age over 85 years, ambulatory

procedures, surgeries < 60 min, performed exclusively under regional anesthesia, pregnancy or breastfeeding, and refusal to participate. Patient inclusion occurred during the before and after phases of the study, with no inclusion during the one-month training phase.

Patient outcomes

The primary outcome was a composite of major postoperative complications occurring within 28 days after surgery, defined as the incidence of at least one of the following: organ system dysfunction, unplanned ICU admission, surgical reintervention, or death. Secondary outcomes included the prevalence of intraoperative hypotension (MAP <60 mmHg), prevalence of PONV, postoperative pain scores (NRS) and length of stay. Each item of the primary composite outcome was also analyzed individually.

Process measures

The intraoperative use and compliance with target ranges for SPI, SE and NMT during anesthesia maintenance were assessed. SE and NMT use were defined by their connection to the anesthesia workstation, while SPI was considered used when the finger pulse oximetry sensor was in place. Compliance was defined as SPI and SE values within target ranges for more than 70% of the maintenance period, and NMT > 90% before extubation. Additionally, the participation and training satisfaction were recorded, as well as pre and post test scores. Participation was defined as attending the in-person lecture, viewing the online module, or taking part in an in-room training session.

Data and outcomes measurement

Outcome assessors were independent of anesthesia delivery and postoperative care but were not blinded to the study's objectives and phases. Postoperative complications were collected from the electronic medical record (Hospital Manager, Softway Medical, France) and a POD28 follow-up phone call. All intraoperative data were extracted from our anesthesia information system (Opesim touch, Evolucare, France) including type of surgery, duration of anaesthesia and patient characteristics (age, ASA status score, preoperatives lab results) and from 12 dedicated operating rooms connected to Carestation™ Insights (GE Healthcare, USA).

This software measured 24/7 SPI and Entropy SE compliance, as well as intraoperative events such as bradycardia and hypotension, and transferred the data to a secure cloud-based dashboard.

Since intraoperative data were recorded anonymously, it was not possible to identify the anesthesia provider responsible for each patient.

Statistical analysis

The sample size was estimated on the assumption of a baseline incidence of complications and mortality of 20%, and an expected reduction to around 15% after training in the use of the Carestation AoA GE device. To reach a power of 80%, with an alpha risk of 5%, we aimed to recruit 638 patients per period. Surgery activity turned out to be lower than expected and given the before-after nature of the study, we were not able to extend the period of recruitment. Posteriori power analysis based on the final sample showed a power of 72% for our primary outcome at the end of the study.

The normality of the distribution of quantitative variables was explored graphically. Patient characteristics were described with absolute numbers and proportions for categorical variables and means and Standard Deviations (SD) for quantitative variables. Comparisons between groups were performed using the Student, or the Mann-Whitney test for quantitative variables and the Chi-square or Fischer test for qualitative variables. To adjust for potential cofounders, the effect of monitoring on the primary outcome and on its component was explored through univariate and multivariate logistic regression models. The results are presented with odds ratios and their 95% confidence intervals. A sensitivity analysis was also performed, where a propensity score was first estimated from variables significantly different between periods. This propensity score was then used in a logistic regression model exploring the effect of the monitoring on the primary outcome and its components.

Secondary endpoints were analyzed according to the same modalities as the primary endpoint when binary. For quantitative endpoint, we used multivariate linear regression.

All analyses were conducted by the medical statistics department at Nîmes University Hospital using R software (V. 4.4.0, R Foundation for Statistical Computing, Vienna, Austria). A two-sided p value of <0.05

was considered as indicating statistical significance.

Results

Nature of setting and improvement intervention

In the before period, 517 participants were included between December 12, 2023, and May 24, 2024. In the after period, 508 participants were included between June 23, 2024, and January 10, 2025 (**Figure 2**). Participant characteristics are presented in **Table 1**. Overall, the mean age was 65 years, and 53.5% of participants were female. Most procedures were scheduled surgeries (88% in the before phase and 94% in the after phase, $p = 0.002$). Open procedures accounted for 44% and 40% of cases, respectively ($p = 0.088$). Intraoperative data are presented in **Supplementary Table 1**.

The training period was conducted from May 27 to June 21, 2024. Among 202 eligible anesthesia providers, 95 participated in the AoA training program (participation rate: 47%). Regarding the pre and post test evaluation, 162 providers completed the pre test and 132 completed the post test (91 trained, 41 untrained). The median score before training was 72 (IQR 65–82), compared to 85 (IQR 77–90) one month after training, a 12-point absolute improvement ($p = 0.001$). Satisfaction was high, with 57.1% ($N = 52$) satisfied and 33.0% ($N = 30$) very satisfied. After the training phase, 93.4% ($N = 85$) of participants reported feeling prepared to apply the new practices.

Changes in processes of care and patient outcomes associated with the intervention

Process of care

SE, SPI, and NMT sensors were simultaneously used in 26% ($N = 134$) of cases in the before period and 42% ($N = 211$) in the after period ($p < 0.001$).

The percentage of time within the target range during a case was similar between periods (for SE: $78\% \pm 27\%$ vs. $76\% \pm 27\%$, $p = 0.2$; for SPI: $69\% \pm 20\%$ vs. $71\% \pm 19\%$, $p = 0.3$). TOF $>90\%$ before extubation was also similar (92% vs. 91% , $p = 0.8$). The overall AoA compliance was observed in 17% of patients in the before period and 23% in the after period ($p = 0.073$). Excluding TOF measures, combined SPI and SE

compliance above 70% of the anesthesia maintenance period was achieved in 23% before and 39% after the intervention ($p < 0.001$).

Primary outcome

The incidence of at least one major postoperative complication or death was similar before and after AoA training (13%, $N = 66$ vs. 14%, $N = 71$; $p = 0.6$) (**Table 2**).

In multivariable logistic regression adjusting for preoperative variables (age, Lee score, diabetes, CKD, and other comorbidities), the intervention was not significantly associated with the composite outcome. A propensity score analysis was also performed, showing similar results. Subgroup analysis by age showed no significant differences.

Secondary outcomes.

Eight deaths occurred during the study period (4 in the before period, 4 in the after period; $p = >0.9$). Analysis of composite-outcome components (**Table 2**) showed a significantly lower incidence of acute kidney injury (AKI- KDIGO stage ≥ 3) in the after period (1.2% vs. 3.3%; $p = 0.023$). Non-significant trends favored the after period for intraoperative hypotension ($MAP < 60$ mmHg; 2.8% vs. 4.8%; $p = 0.082$) and postoperative respiratory complications (2.2% vs. 4.1%; $p = 0.081$). In multivariable analyses (**Table 3**), the intervention was independently associated with reduced risks of IOH, postoperative respiratory complications, and AKI (KDIGO stage ≥ 3). Vasopressor use was consistent across periods, with similar total doses of ephedrine and norepinephrine (**Table 2**).

Other secondary outcomes are presented in Table 2. The incidence of PONV in the PACU and on POD1 was similar between periods. Pain scores at rest on POD1 and on POD2 were also similar. Lengths of stay were longer in the after period (PACU: median 122 [96–162] vs. 114 [87–147] minutes, $p = 0.001$; hospital: 4.0 [3.0–7.3] vs. 3.0 [2.0–5.0] days, $p < 0.001$). In detail, admission to the High Dependency Unit (HDU) was more frequent in the after period (20% vs 13%; $p = 0.006$). (**Supplementary Table 1**).

Discussion

In this before–after study, a hybrid educational program did not reduce the incidence of major postoperative complications in patients undergoing intermediate-high-risk scheduled surgery. Despite the absence of clinical benefit on the primary outcome, the intervention was associated with significant improvements in intraoperative anesthesia practices, as well as reductions in intraoperative hypotension (IOH) , postoperative acute kidney injury (AKI) and postoperative respiratory complications at POD28.

These findings raise important questions about how best to implement DOA and nociception monitoring in routine clinical care to achieve patient relevant benefits.

Implementing advanced monitoring in the operating room is defined as a complex intervention (17,18). Beyond introducing new devices, it requires behavioral change among providers, integration into existing workflows, and adaptation to the local context (18).

Consequently, the AoA educational program was developed in accordance with the Medical Research Council (MRC) framework for complex interventions (18), with particular attention to stakeholder involvement, feasibility, and optimal implementation. Additionally, its evaluation followed the Kirkpatrick conceptual framework (19), which assesses the implementation of quality improvement initiatives across four levels: satisfaction (Level 1), knowledge acquisition (Level 2), behavioral change (Level 3), and, ultimately, clinical outcomes (Level 4), the most difficult to achieve.

After training, participant satisfaction and knowledge acquisition were both high, with a 12% improvement in post-training scores. Yet, the limited margin for progression may have reflected a ceiling effect in knowledge acquisition, as high baseline scores suggest prior familiarity with SPI and SE monitoring among participants.

In the operating room setting, the AoA training was associated with increased use of the monitors. Notably, SE + SPI compliance was significantly higher after the intervention (39% vs. 23%, $p < 0.001$), indicating greater integration of monitoring data into intraoperative decision-making. The Balance View interface may have facilitated integration by providing an intuitive visual aid. These results suggest an overall

positive impact of the training on clinical behavior.

In terms of postoperative outcomes, the training was independently associated with a reduced incidence of IOH, AKI, and postoperative pulmonary complications in multivariate analysis. Lower IOH after training may reflect improved anesthetic gas titration supported by SE monitoring (20). Given that IOH is a recognized risk factor for postoperative complications via organ hypoperfusion (21), the observed reduction in AKI aligns with existing evidence (22). This result is particularly relevant given the higher proportion of patients with chronic kidney disease (CKD) in the post-intervention cohort, a population more susceptible to renal injury. Reduced pulmonary complications were not explained by patient or procedural factors ; including LPV compliance or adequate TOF at extubation ; suggesting other aspects of intraoperative management may have improved.

Our lower incidence of MAP <60 mmHg occurred without higher vasopressor use. This aligns with the POISE-2 substudy by Sessler et al. (23) linking perioperative hypotension with myocardial infarction and 30-day mortality, and with the Cleveland Clinic analysis by Salmasi et al. (24) showing graded associations between MAP <65 mmHg and both acute kidney injury and myocardial injury. Together, these data support that improved hemodynamic control—rather than intensified vasopressor administration—likely explains part of the observed benefit.

The current limited clinical impact of advanced intraoperative monitoring systems and machine learning (25) may be explained by several factors. First, large randomized controlled trials are lacking to specifically explore their effect on standardized endpoints (25).

Second, physician compliance and trust remain key limitations. Sessler et al. failed to reduce 90-day postoperative mortality despite implementing real-time alerts for the "triple low" condition (26), as most alerts were ignored by clinicians. Similarly, postoperative complications were not improved within the use of a multiparameter intraoperative decision-support system (27). These findings highlight the complexity of changing clinical behavior. Third, a decision-making algorithm is required to support clinical decisions, rather than simply displaying raw real-time data on a screen.

Nevertheless, the absence of a reduction in the overall postoperative complication rate in our study

highlights the multifactorial nature of postoperative morbidity, influenced by patient comorbidities, surgical complexity, and the quality of the entire perioperative care continuum.

Reducing morbidity likely requires comprehensive, multimodal strategies such as ERAS protocols (28), with adherence being crucial to realize benefits.

Our study has several limitations. First, this trial was prospective but not randomized, which limits the strength of our conclusion. Including a concurrent control group would have better accounted for secular trends over time due to natural practice changes unrelated to the training intervention. However, our hospital was the only French center equipped with Carestation™ Insights solution at the time of patient inclusion, which limited the feasibility of a concurrent control group. Second, anesthesia providers were aware of the study, creating a potential Hawthorne effect. To minimize this risk, data from the Before phase were not disclosed to participants during the study period. Moreover, because data were collected prospectively in both periods, any Hawthorne effect likely affected both rather than only the After period (29). Third, implementation fidelity of the AoA training program likely varied across anesthesia providers, with different learning curves and levels of confidence in monitoring. To address this, individualized bedside sessions were used to personalize training. However, no post-training reminders such as on-screen pop-ups were implemented in the After period, which may have reduced sustained compliance with monitoring targets (17). Additionally, participation was voluntary, thus the participation rate was 47%, which may have limited the extent of change in clinical practice. Fourth, the study period was limited to one year. An interrupted time-series analysis over a longer horizon would better assess practice persistence and temporal effects (29) Fifth, the study may have been underpowered to detect modest differences in infrequent outcomes.

Finally, external validity is limited to a single-center setting with specific monitoring technologies and institutional practices. Future multicenter or randomized stepped-wedge trials are warranted to confirm and extend these findings.

In conclusion, An AoA-focused educational program improved intraoperative monitoring practices but did not reduce the incidence of a composite of major postoperative complications at POD28. Observed

improvements in intraoperative hypotension, acute kidney injury, and respiratory complications suggest potential benefits from standardized clinical decision algorithms and broader multimodal anesthesia pathways.

Bibliographie

(1): Laferrière-Langlois P, Morisson L, Jeffries S, Duclos C, Espitalier F, Richebé P. Depth of Anesthesia and Nociception Monitoring: Current State and Vision For 2050. *Anesth Analg*. 2024 Feb 1;138(2):295-307.

(2): Wildes TS, Mickle AM, Ben Abdallah A, Maybrier HR, Oberhaus J, Budelier TP, Kronzer A, McKinnon SL, Park D, Torres BA, Graetz TJ, Emmert DA, Palanca BJ, Goswami S, Jordan K, Lin N, Fritz BA, Stevens TW, Jacobsohn E, Schmitt EM, Inouye SK, Stark S, Lenze EJ, Avidan MS; ENGAGES Research Group. Effect of Electroencephalography-Guided Anesthetic Administration on Postoperative Delirium Among Older Adults Undergoing Major Surgery: The ENGAGES Randomized Clinical Trial. *JAMA*. 2019 Feb 5;321(5):473-483.

(3) : Evered LA, Chan MTV, Han R, Chu MHM, Cheng BP, Scott DA, Pryor KO, Sessler DI, Veselis R, Frampton C, Sumner M, Ayeni A, Myles PS, Campbell D, Leslie K, Short TG. Anaesthetic depth and delirium after major surgery: a randomised clinical trial. *Br J Anaesth*. 2021 Nov;127(5):704-712.

(4): Zhou L, Ding L, Yang H, Li C, Yu Z, Ma W, Chen Q, Zhang Y, Li Y, Mao Q, Cheng M, Gong G, Wang E, Liu C, Hao W, Li H, Chen C, Fan Y, Su Z, Cai X, Zhang X, Li Z, Zhang B, Li Y, Jiang C, Yin Q, Jiao J, Sessler DI, Li Q, Liu J. Bispectral Index-Guided Anesthesia for Older Patients Having Non-Cardiac Surgery: A Randomized Multicenter Trial. *Anesthesiology*. 2025 Sep 25.

(5) Snoek MAJ, van den Berg VJ, Dahan A, Boon M. Comparison of different monitors for measurement of nociception during general anaesthesia: a network meta-analysis of randomised controlled trials. *Br J Anaesth*. 2025 Jan;134(1):180-191.

(6) Guyot A, Rouxel P, Jaber S, Pereira B, Lambert C, Futier E, Beloeil H. Personalised

analgesia/nociception index-guided opioid administration for abdominal surgery: A randomised trial. Eur J Anaesthesiol. 2025 Jul 1;42(7):651-653.

(7): *Aldecoa C, Bettelli G, Bilotta F, Sanders RD, Aceto P, Audisio R, Cherubini A, Cunningham C, Dabrowski W, Foroookhi A, Gitti N, Immonen K, Kehlet H, Koch S, Kotfis K, Latronico N, MacLulich AMJ, Mevorach L, Mueller A, Neuner B, Piva S, Radtke F, Blaser AR, Renzi S, Romagnoli S, Schubert M, Slooter AJC, Tommasino C, Vasiljewa L, Weiss B, Yuerek F, Spies CD. Update of the European Society of Anaesthesiology and Intensive Care Medicine evidence-based and consensus-based guideline on postoperative delirium in adult patients. Eur J Anaesthesiol. 2024 Feb 1;41(2):81-108.*

(8): *Gruenewald M, Harju J, Preckel B, Molnár Z, Yli-Hankala A, Roskopf F, Koers L, Orban A, Bein B; AoA Study Group. Comparison of adequacy of anaesthesia monitoring with standard clinical practice monitoring during routine general anaesthesia: An international, multicentre, single-blinded randomised controlled trial. Eur J Anaesthesiol. 2021 Jan;38(1):73-81.*

(9) *Tevis SE, Kennedy GD. Postoperative complications and implications on patient-centered outcomes. J Surg Res. 2013 May 1;181(1):106-13.*

(10): *Downey CL, Bainbridge J, Jayne DG, Meads DM. Impact of in-hospital postoperative complications on quality of life up to 12 months after major abdominal surgery. Br J Surg. 2023 Aug 11;110(9):1206-1212.*

(11) *Berkowitz R, Vu J, Brummett C, Waljee J, Englesbe M, Howard R. The Impact of Complications and Pain on Patient Satisfaction. Ann Surg. 2021 Jun 1;273(6):1127-1134.*

(12) *Eappen S, Lane BH, Rosenberg B, Lipsitz SA, Sadoff D, Matheson D, Berry WR, Lester M, Gawande AA. Relationship between occurrence of surgical complications and hospital finances. JAMA. 2013 Apr 17;309(15):1599-606.*

(13): *Coeckelenbergh S, Richebé P, Longrois D, Joosten A, De Hert S. Current trends in anesthetic depth and antinociception monitoring: an international survey. J Clin Monit Comput. 2022 Oct;36(5):1407-1422.*

(14): *Gandon C, Gricourt Y, Thomas M, Garnaud B, Elhaj M, Boisson C, Boudemaghe T, Jaber S, Claret PG, Cuvillon P. How traditional and digital analytics interventions can enhance lung-protective ventilation*

strategies during general anaesthesia: A two-year quality improvement project analysis. Anaesth Crit Care Pain Med. 2022 Dec;41(6):101143.

(15) Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf. 2016 Dec;25(12):986-992.*

(16) Halvorsen S, Mehilli J, Cassese S, Hall TS, Abdelhamid M, Barbato E, De Hert S, de Laval I, Geisler T, Hinterbuchner L, Ibanez B, Lenarczyk R, Mansmann UR, McGreavy P, Mueller C, Muneeretto C, Niessner A, Potpara TS, Ristić A, Sade LE, Schirmer H, Schüpke S, Sillesen H, Skulstad H, Torracca L, Tutarel O, Van Der Meer P, Wojakowski W, Zacharowski K; ESC Scientific Document Group. 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery. *Eur Heart J. 2022 Oct 14;43(39):3826-3924.*

(17): Gandon C, Gricourt Y, Thomas M, Garnaud B, Elhaj M, Boisson C, Boudemaghe T, Jaber S, Claret PG, Cuvillon P. How traditional and digital analytics interventions can enhance lung-protective ventilation strategies during general anaesthesia: A two-year quality improvement project analysis. *Anaesth Crit Care Pain Med. 2022 Dec;41(6):101143.*

(18): Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French DP, McIntosh E, Petticrew M, Rycroft-Malone J, White M, Moore L. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ. 2021 Sep 30;374:n2061.*

(19): Smidt A, Balandin S, Sigafos J, Reed VA. The Kirkpatrick model: A useful tool for evaluating training outcomes. *J Intellect Dev Disabil. 2009 Sep;34(3):266-74.*

(20): El Hor T, Van Der Linden P, De Hert S, Mélot C, Bidgoli J. Impact of entropy monitoring on volatile anesthetic uptake. *Anesthesiology. 2013 Apr;118(4):868-73.*

(21): Wesselink EM, Kappen TH, Torn HM, Slooter AJC, van Klei WA. Intraoperative hypotension and the risk of postoperative adverse outcomes: a systematic review. *Br J Anaesth. 2018 Oct;121(4):706-721.*

(22): Penev Y, Ruppert MM, Bilgili A, Li Y, Habib R, Dozic AV, Small C, Adiyeye E, Ozrazgat-Baslanti T,

Loftus TJ, Giordano C, Bihorac A. Intraoperative hypotension and postoperative acute kidney injury: A systematic review. *Am J Surg*. 2024 Jun;232:45-53.

(23) Sessler DI, Meyhoff CS, Zimmerman NM, Mao G, Leslie K, Vásquez SM, Balik M, Kildeso J, Osterman V, Graham SM, et al. "Period-dependent associations between hypotension during and for four days after noncardiac surgery and a composite of myocardial infarction and death: a substudy of the POISE-2 trial." *Anesthesiology*. 2019;130(5):745-55.

(24): Salmasi V, Maheshwari K, Yang D, Mascha EJ, Singh A, Sessler DI, Kurz A. Relationship between intraoperative hypotension, defined by either reduction from baseline or absolute thresholds, and acute kidney and myocardial injury after noncardiac surgery: a retrospective cohort analysis. *Anesthesiology*. 2017;126(1):47-65.

(25): Mehta D, Gonzalez XT, Huang G, Abraham J. Machine learning-augmented interventions in perioperative care: a systematic review and meta-analysis. *Br J Anaesth*. 2024 Dec;133(6):1159-1172. doi: 10.1016/j.bja.2024.08.007. Epub 2024 Sep 24. PMID: 39322472; PMCID: PMC11589382.

(26): Sessler DI, Turan A, Stapelfeldt WH, Mascha EJ, Yang D, Farag E, Cywinski J, Vlah C, Kopyeva T, Keebler AL, Perilla M, Ramachandran M, Drahuschak S, Kaple K, Kurz A. Triple-low Alerts Do Not Reduce Mortality: A Real-time Randomized Trial. *Anesthesiology*. 2019 Jan;130(1):72-82.

(27): Kheterpal S, Shanks A, Tremper KK. Impact of a Novel Multiparameter Decision Support System on Intraoperative Processes of Care and Postoperative Outcomes. *Anesthesiology*. 2018 Feb;128(2):272-282.

(28): Sauro KM, Smith C, Ibadin S, Thomas A, Ganshorn H, Bakunda L, Bajgain B, Bisch SP, Nelson G. Enhanced Recovery After Surgery Guidelines and Hospital Length of Stay, Readmission, Complications, and Mortality: A Meta-Analysis of Randomized Clinical Trials. *JAMA Netw Open*. 2024 Jun 3;7(6):e2417310.

(29): Ho AMH, Phelan R, Mizubuti GB, Murdoch JAC, Wickett S, Ho AK, Shyam V, Gilron I. Bias in Before-After Studies: Narrative Overview for Anesthesiologists. *Anesth Analg*. 2018 May;126(5):1755-1762. doi: 10.1213/ANE.0000000000002705. PMID: 29239959.

Annexes

Figure 1 : Fishbone diagram

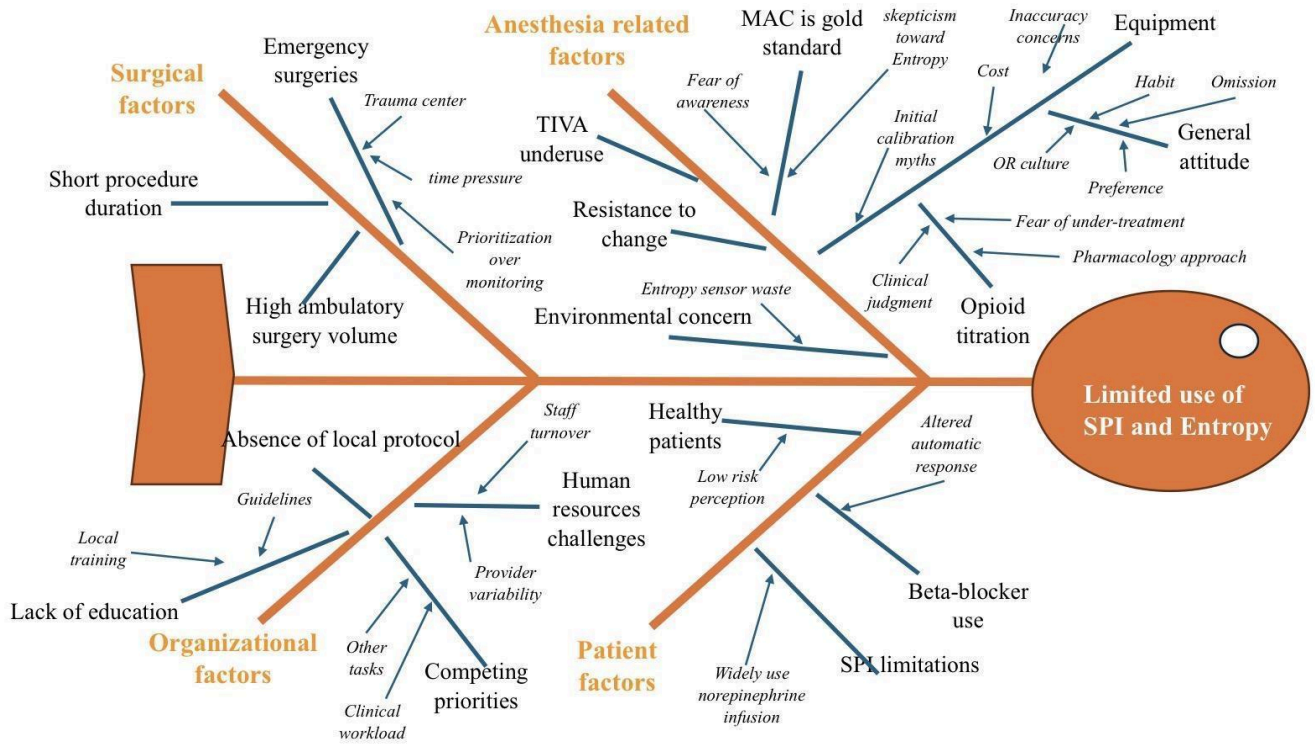


Figure 2 : flow chart

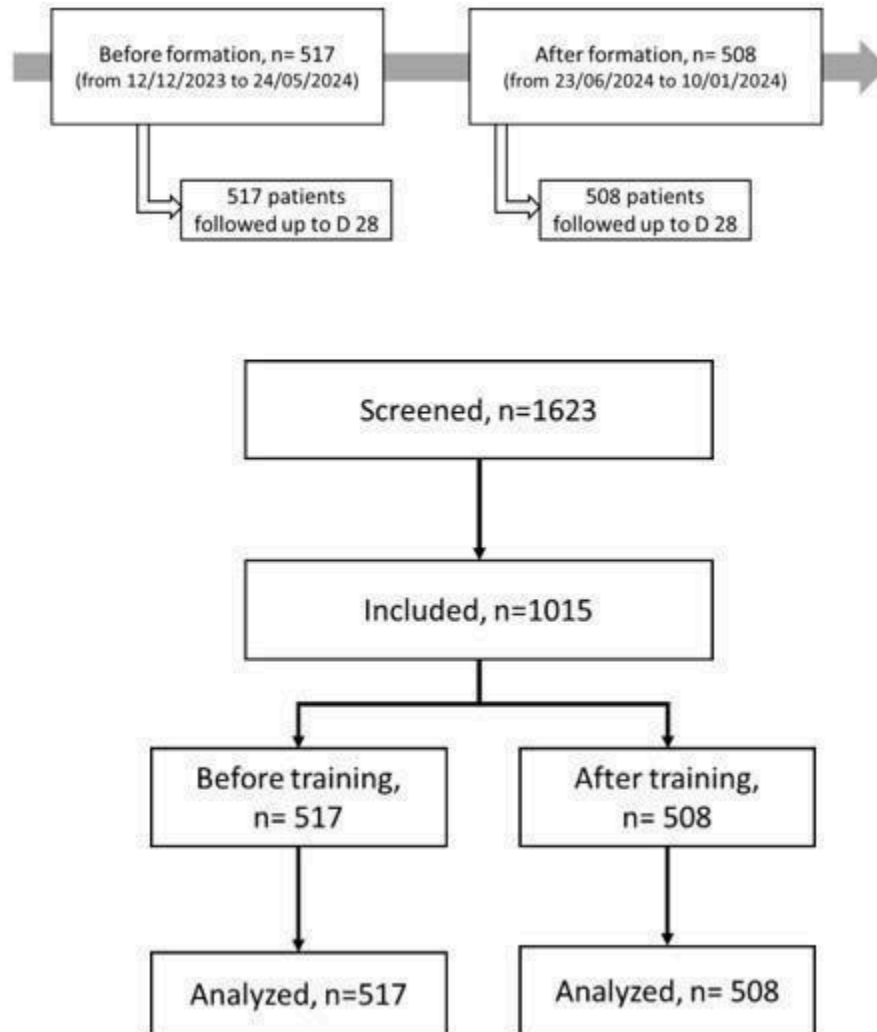


Table 1 : Baseline Demographic and Clinical Characteristics of the Patients

Characteristics	Before phase (N=517)	After phase (N=508)	p-values
Age, years	65 ± 13	66 ± 14	0.053
Female sex	281 (54%)	270 (53%)	0.7
Weight (kg)	77 ± 18	77 ± 17	0.8
Body mass index (kg/m ²)	27.2 ± 6.2	27.2 ± 5.5	0.7
<i>Lee score</i>			0.003
0	330 (64%)	298 (59%)	
1	136 (26%)	133 (26%)	
>2	48 (9.4%)	77 (15/1%)	
<i>ASA score</i>			0,3
II	301 (58%)	275 (54%)	
III	199 (38%)	220 (43%)	
IV	17 (3.3%)	13 (2.6%)	
<i>Medical history</i>			
Hypertension	213 (45%)	227 (49%)	0.2
Coronary artery disease	50 (11%)	56 (12%)	0.5
Non-ischemic heart disease	56 (12%)	57 (12%)	0.8
Cerebrovascular disease	16 (3.4%)	14 (3%)	0.7
Diabetes mellitus			0.9
<i>Insulin treated</i>	16 (21%)	21 (22%)	
<i>Non-insulin treated</i>	61 (79%)	75 (78%)	
COPD	47 (9.9%)	59 (13%)	0.2
Asthma	24 (5%)	23 (4.9%)	>0.9
Sleep apnea	62 (13%)	63 (13%)	0.8
<i>With CPAP therapy</i>	29 (48%)	27 (44%)	0.7
Chronic renal disease	39 (8.2%)	59 (13%)	0.026
Solid cancer	128 (27%)	133 (28%)	0.6
<i>Current medications</i>			
Beta-blockers	94 (24%)	96 (26%)	0.4
Calcium channel blocker	81 (21%)	90 (25%)	0.4
ACE inhibitors	155 (39%)	165 (45%)	0.089
Diuretics	67 (17%)	53 (15%)	0.4
SGLT2 inhibitor	30 (7.6%)	27 (7.4%)	>0.9
Oral antidiabetic	62 (16%)	73 (20%)	0.11
Antiplatelet agents	124 (31%)	130 (36%)	0.2
Anticoagulants	21 (5.3%)	20 (5.5%)	>0.9
<i>Preoperative laboratory values:</i>			
Hemoglobin (g/dL)	13.3 ± 1.77	13.2 ± 1.71	0.3
Serum creatinine (µmol/L)	82 ± 48	83 ± 47	0.9
eGFR (mL/min/1.73 m ²)	80 ± 20	79 ± 21	0.6

Data are presented as mean (SD) or n (%).

Legend: ASA = American Society of Anesthesiologists physical status; BMI = body mass index; eGFR = estimated glomerular filtration rate; ACE = angiotensin-converting enzyme; CPAP = continuous positive airway pressure; SGLT2 = sodium–glucose cotransporter-2; COPD = chronic obstructive pulmonary disease.

Table 2 : Patient outcomes

Outcomes	Before phase (N=517)	After phase (N=508)	P value
<i>Primary outcome</i>			
Major postoperative complications at POD28	66 (13%)	71 (14%)	0.6
<i>Secondary outcomes</i>			
Type of complications			
IOH (MAP < 60mmHg)	25 (4.8%)	14 (2.8%)	0.082
AMI	0	0	>0.9
Arterial or venous thrombosis	7 (1.4%)	6 (1.2%)	0.8
Stroke	1 (0.2%)	1 (0.2%)	>0.9
Cardiogenic shock	2 (0.4%)	5 (1.0%)	0.3
Cardiac arrhythmia	9 (1.7%)	7 (1.4%)	0.6
Sepsis	36 (7.0%)	37 (7.3%)	0.8
Respiratory complications	21 (4.1%)	11 (2.2%)	0.081
AKI (KDIGO stage 3)	17 (3.3%)	6 (1.2%)	0.023
Surgical complications	32 (6.2%)	32 (6.3%)	>0.9
Unplanned ICU admission	18 (3.5%)	12 (2.4%)	0.3
Other complications	51 (9.9%)	58 (11%)	0.4
Postoperative nausea			
PACU	31 (6.1%)	28 (5.5%)	0.7
POD1	36 (7.3%)	28 (6.1%)	0.5
POD2	13 (3.8%)	4 (1.9%)	0.2
Postoperative vomiting			
PACU	6 (1.2%)	5 (1.0%)	0.8
POD1	11 (2.2%)	9 (2.0%)	0.8
POD2	8 (2.3%)	2 (0.9%)	0.3
Postoperative pain score (NRS), at rest			
POD1	2.00 [0.00; 4.00]	2.00 [0.00; 4.00]	0.4
POD2	2.00 [0.00; 4.00]	2.00 [0.00; 4.00]	0.066
LOS in PACU, min	114 [87; 147]	122 [96; 162]	0.001
LOS in hospital, days	3.0 [2.0; 5.0]	4.0 [3.0; 7.3]	<0.001
LOS in ICU #, days	8 [5; 12]	5 [5; 7]	0.2

The values are means \pm SD, n (%).

Major postoperative complications were defined as the occurrence of at least one of the following events within 28 days after surgery: acute myocardial infarction (AMI); arterial or venous thrombosis; stroke; postoperative cardiogenic shock requiring ICU(intensive care unit) transfer and inotropic support with dobutamine; severe intraoperative arterial hypotension (MAP < 60 mmHg); cardiac arrhythmia (new-onset atrial fibrillation, atrial flutter, ventricular tachycardia, or ventricular fibrillation); postoperative sepsis or infection (according to international 2001 sepsis definitions); postoperative respiratory complication (defined as the need for intubation, noninvasive ventilation, or high-flow oxygen therapy for acute respiratory failure); acute kidney injury (KDIGO stage 3 or requiring renal replacement therapy); surgical complication (requiring reoperation for any cause or radiologic drainage of abscess or hematoma); unplanned ICU admission or readmission; or any other severe complication.

Among patients admitted to the ICU, 20 were in the before phase and 15 in the after phase

Legend: IOH = intraoperative hypotension; MAP = mean arterial pressure; AMI = acute myocardial infarction; AKI = acute kidney injury; KDIGO = Kidney Disease: Improving Global Outcomes; ICU = intensive care unit; PACU = post-anesthesia care unit; NRS = Numeric Rating Scale; LOS = length of stay

Table 3 : Multivariate Analysis

Table 3. Impact of the AoA Training Program on Major Complications (Adjusted Multivariate Analysis)

Outcomes	Adjusted Odds ratio (95 % CI)	P value
IOH (MAP < 60mmHg)	0.45 [0.22 - 0.89]	0.024
Respiratory complications	0.44 [0.20 - 0.92]	0.034
AKI (KDIGO stage 3)	0.23 [0.08 - 0.59]	0.004

Adjusted odds ratios (OR) with 95% confidence intervals (CI). OR < 1 indicates a reduced risk of complications in the after period compared with the before period.

Legend: AoA = adequacy of anesthesia; AKI = acute kidney injury; KDIGO = Kidney Disease: Improving Global Outcomes.

Supplementary Table 1. Intraoperative data

Characteristics	Before phase (N=517)	After phase (N=508)	p-values
Length of surgery, min	138±83	156±92	<0.001
Elective surgeries	455 (88%)	475 (94%)	0.002
<i>Surgical approaches</i>			0.088
Laparoscopic assisted	152 (30%)	138 (28%)	
Robotic assisted	135 (26%)	165 (32%)	
Open surgery	228 (44%)	205 (40%)	
<i>Surgical specialty</i>			0.2
Orthopedics	159 (31%)	130 (26%)	
General	131 (25%)	117 (23%)	
Urology	99 (19%)	109 (21%)	
Gynecology	68 (13%)	78 (15%)	
Thoracic	9 (1.7%)	18 (3.5%)	
Other	51 (9.9%)	56 (11%)	
Estimated blood loss, mL	165 ± 264	184 ± 295	0.025
Intraoperative blood transfusion	31 (6%)	24 (4.7%)	0.4
Transfused blood volume, mL	524 [285; 619]	595 [481; 651]	0.3
Minimum intraoperative temperature, °C	35.87 ± 0.54	35.84±0.57	0.6
Length of anesthesia, min	197±96	216±103	<0.001
Sevoflurane maintenance	512 (99%)	503 (99%)	0.5
<i>Intraoperative ventilatory parameters</i>			
Maximum tidal volume, mL/kg PBW	464 ± 81	482 ± 77	<0.001
Maximum respiratory rate, breaths/min	16.05 ± 2.53	16.51 ± 2.51	0.003
Recruitment maneuver performed	456 (90%)	468 (93%)	0.14
Prophylactic antibiotics	435 (85%)	422 (83%)	0.5
<i>Intraoperative hemodynamic parameters</i>			
Minimum SAP, mmHg	79±14	80±15	0.6
Minimum MAP, mmHg	61±11	59±10	0.2
Total intraoperative fluid volume	1.000 [500; 1.500]	1000 [750; 1.700]	0.10
<i>Vasopressor used</i>			
Noradrenaline	451 (87%)	447 (88%)	0.7
Dose in µg	1,060±1,166	1,249±1,638	0.3
Ephedrine	59 (11%)	37 (7.3%)	0.023
Dose in mg	13±7	10±4	0.13
Use of any vasopressor	467 (90%)	456 (90%)	0.8
Regional anesthesia	422 (83%)	439 (87%)	0.065
<i>Postoperative admission</i>			0.006
Surgical ward	427 (83%)	391 (77%)	
Expected HDU	65 (13%)	102 (20%)	
Expected ICU	9 (1.7%)	7 (1.4%)	
Unexpected HDU or ICU	16 (3.1%)	8 (1.6%)	

Values are presented as mean ± SD, median [IQR], or number (%) as appropriate.

Legend: PBW = predicted body weight; PEEP = positive end-expiratory pressure; SAP = systolic arterial pressure; MAP = mean arterial pressure; HDU = High Dependency Unit; ICU = Intensive Care Unit. Expected HDU/ICU

refers to planned postoperative admission, while Unexpected HDU/ICU corresponds to unplanned escalation of postoperative care.

Serment

En présence des Maîtres de cette école, de mes chers condisciples et devant l'effigie d'Hippocrate, je promets et je jure, au nom de l'Être suprême, d'être fidèle aux lois de l'honneur et de la probité dans l'exercice de la médecine.

Je donnerai mes soins gratuits à l'indigent et n'exigerai jamais un salaire au-dessus de mon travail.

Admis·e dans l'intérieur des maisons, mes yeux ne verront pas ce qui s'y passe, ma langue taira les secrets qui me seront confiés et mon état ne servira pas à corrompre les mœurs ni à favoriser le crime.

Respectueux·se et reconnaissant·e envers mes Maîtres, je rendrai à leurs enfants l'instruction que j'ai reçue d'eux.

Que les hommes et les femmes m'accordent leur estime si je suis fidèle à mes promesses. Que je sois couvert·e d'opprobre et méprisé·e de mes consoeurs et confrères si j'y manque.

Résumé en anglais

Keywords: Nociception, Entropy, Blood pressure, outcomes, quality

Abstract:

Background : Depth of anesthesia and nociception monitors are increasingly used, but their impact on patient relevant outcomes remains uncertain. We evaluated whether a hybrid educational program to support adequacy-of-anesthesia (AoA) monitoring (Entropy SE, Nociception Index SPI, Curarisation) improves postoperative outcomes .

Method : Prospective before–after quality-improvement study at a tertiary hospital. Two sequential periods were analyzed (12/12/2023–05/24/2024; 06/23/2024–01/10/2025). Adults (≥ 18 years) undergoing non-cardiac intermediate /high-risk surgery under general anesthesia lasting ≥ 60 minutes were included. The intervention combined a lecture, bedside coaching, and decision-support display; targets were SE 40–60, SPI 20–50, and NMT $>90\%$ before extubation. The primary outcome was a composite of major complications or death by postoperative day 28 (POD28). Analyses included multivariable logistic regression and propensity-score sensitivity analysis.

Results: 1,025 patients were included (517 before, 508 after). Simultaneous SE+SPI+NMT use increased from 26% to 42% ($p < 0.001$). Overall AoA compliance rose from 17% to 23% ($p = 0.073$); excluding TOF measures , SE+SPI compliance increased from 23% to 39% ($p < 0.001$). The primary composite outcome was similar before vs after (13% vs 14%, $p = 0.60$). Acute Kidney Injury (KDIGO ≥ 3) was lower after the intervention (1.2% vs 3.3%, $p = 0.023$). Non-significant trends favored the after period for intraoperative hypotension (IOH) and postoperative pulmonary complications; adjusted analyses showed independent associations between the intervention and lower IOH, postoperative AKI and pulmonary complications.

Conclusion: An AoA-focused educational program improved intraoperative monitoring practices without reducing the incidence of a major postoperative complications composite outcome at POD28. Observed improvements in IOH, AKI, and respiratory complications suggest potential benefits from standardized clinical decision algorithms and broader multimodal anesthesia pathways.

Résumé en français

Mots-clés : Nociception ; Entropie ; Pression artérielle ; Résultats cliniques ; Qualité des soins

Contexte : Les moniteurs de profondeur d'anesthésie et de nociception sont de plus en plus utilisés, mais leur intérêt sur le devenir (morbidité, mortalité) des patients reste controversé. Nous avons évalué l'intérêt d'un programme de formation hybride soutenant l'"adequacy-of-anesthesia" (AoA ; Entropy SE, Nociception Index SPI, Curarisation) sur la morbidité et mortalité postopératoire.

Méthodes : Étude de type amélioration de la qualité, prospective avant-après. Deux périodes consécutives ont été analysées (du 12 décembre 2023 au 24 mai 2024 ; du 23 juin 2024 au 10 janvier 2025). Ont été inclus des adultes (≥ 18 ans) bénéficiant d'une chirurgie non cardiaque à risque intermédiaire/élevé sous anesthésie générale d'une durée ≥ 60 minutes. La formation associait "cours magistral, un accompagnement au bloc et une interface d'aide à la décision" avec les objectifs en peropératoire : SE 40–60, SPI 20–50, et NMT >90 % avant l'extubation. Le critère principal de jugement était un score composite de complications majeures et décès à J28 postopératoire (POD28). Les analyses comprenaient une régression logistique multivariée et une analyse de sensibilité par score de propension.

Résultats : 1 025 patients ont été inclus (517 avant, 508 après). L'utilisation simultanée SE+SPI+NMT est passée de 26 % à 42 % ($p < 0,001$). La conformité globale à l'AoA est passée de 17 % à 23 % ($p = 0,073$) ; en excluant la mesure du TOF, la conformité SE+SPI a augmenté de 23 % à 39 % ($p < 0,001$). Le critère composite de jugement principal était semblable pour les périodes avant vs après (13 % vs 14 %, $p = 0,60$). Les complications rénales aiguës (AKI, KDIGO ≥ 3) étaient moins fréquentes après l'intervention (1,2 % vs 3,3 %, $p = 0,023$). Des tendances non significatives allaient en faveur de la période après pour l'hypotension intraopératoire (IOH) et les complications pulmonaires postopératoires ; les analyses ajustées montraient des associations indépendantes entre l'intervention et une diminution de l'HIO, des complications rénales et pulmonaires post opératoire.

Conclusion : Un programme de formation centré sur l'AoA (Adequacy of Anesthesia) a permis d'améliorer les pratiques de monitoring peropératoire sans réduire l'incidence du critère composite majeur de complications postopératoires à J28. Les améliorations observées concernant l'hypotension

peropératoire (HIO), l'insuffisance rénale aiguë (AKI) et les complications respiratoires suggèrent des bénéfices potentiels liés à l'utilisation d'algorithmes décisionnels standardisés et de parcours d'anesthésie multimodale élargis.