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Brief Report

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Low Postoperative Delirium Risk after Elective Orthopedic Fast-Track Procedures

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Abstract

Introduction: *The current status of postoperative delirium (POD) risk in selected orthopedic elective surgery cohorts is unclear. The influence of fast-track surgery, in combination with regional anesthetic nerve blocks, BIS-monitoring and modernized patient trajectories, may well reduce POD risk, even in an elderly population.*
Methods: *An observational cohort, screening for postoperative delirium using the Nu-DESC (Nursing-Delirium Screening Scale) in 879 consecutive elective orthopedic surgery patients. Nu-DESC rating at 4 preset time points; preoperatively, at emergence, at post-anesthesia care unit (PACU) admittance, at PACU discharge.*
Results: *Overall, 6 of the (n=) 879 participants (0.68%) scored ≥2 Nu-DESC points when interviewed at PACU discharge. These were distributed amongst surgical categories as follows; Knee (0.0%), Hip (2 out of 227 = 0.88%), Shoulder (0 out of 70 = 0%), Minor Lumbar Spine (1 out of 226 = 0.44%), and Major Lumbar spine (3 out of 129 = 2.3%). 3.98% of all patients scored ≥2 NuDESC at PACU arrival. Though there was a significant overrepresentation of general anesthesia patients among ≥2 NuDESC, these select patients were not related to BIS-monitoring or Ketamine infusion, and inversely correlated to spinal anesthesia and regional anesthetic nerve blocks.*
Discussion: *We report a lower-than anticipated incidence of POD-related ≥2 NuDESC scores at PACU discharge in a selected, elective orthopedic surgery cohort, but still a significant incidence at PACU arrival. Modern anesthesia management and techniques may help lower clinical POD in the elderly patient.*

Keywords: *Postoperative delirium; Delirium score; orthopedic surgery; fast-track; patient pathways; regional anesthesia.*

1. Introduction

Delirium is reportedly commonplace, it carries untoward costs-humanly and financially, and is generally preventable. Postoperative delirium (POD) has been reported with wide ranging incidences, dependent on reporting year and type of surgery. POD specifically is a growing public health concern, occurring with an incidence of 20 to 50% in those older than 60 after major surgery [1,2].

Postoperative cognitive dysfunction and risk of delirium and can be evaluated by brief, relatable screening tests that have shown their clinical effectiveness in reducing delirium [3].

Whilst it is clear that the circumstances may pose a significant role in the development of POD and eventual delirium, it is thus far unclear what the role is of modern anesthetic practices such as fast-track surgeries [4], regional pain blocks, and augmented patient preparedness [5] including web-based information technology [6] on the outcome of POD risk.

We here aim to elucidate the current risk of POD in a large, systematic observational cohort in elective orthopedic surgery, including major arthroplasty and lower lumbar spine surgery. The primary outcome was frequency of POD.

2. Methods and materials

2.1 Setting: A non-interventional systematic observational study in consecutive elective surgeries at a university-affiliated tertiary referral clinic, specialized in fast-tracked orthopedics. Institutional consent, regional ethics review board acceptance, and EudraCT registration (no. 2021-003571-34) were obtained in advance.

The Danish language version of Nu-DESC rating [7], a validated and referable tool for POD screening, was performed at 4 preset time points during the day of surgery; (i) before anesthesia induction in the OR department, (ii) at anesthesia emergence, or at surgery completion in the event of spinal anesthesia, (iii) at admittance to post-anesthesia care unit (PACU), (iv) at discharge from PACU.

2.2 Participant allocation was according to surgery type: (1) knee arthroplasty, (2) hip arthroplasty, (3) shoulder decompression or reconstruction incl. total shoulder arthroplasty, (4) minor lumbar (decompression), or (5) major instrumented or un-instrumented lumbar (fusion) surgery. All surgery was elective at the Center for Elective Surgery, Silkeborg, Denmark.

Co-factors which could sway or affect POD, such as NRS pain score, use of regional anesthesia, ultrasound-guided anesthetic nerve blocks for postoperative pain control, use of BIS/Entropy, ketamine infusion and general background descriptive characteristics, were simultaneously recorded.

2.3 Eligibility: Participants were 18+ years of age, scheduled for elective orthopedic surgery under either general (GA) or regional anesthesia and where informed verbal consent was given. No exclusion criteria were employed.

The sample size was planned in advance to include 200 participants per group in order to detect very low incidences yet still be able to discriminate between groups and retain clinical meaningfulness.

2.4 Statistics were calculated using: MedCalc (MedCalc® Statistical Software v.20.026) and in the presentation of the results. To increase the quality of data analyses each set of data was tested for normal distribution (D'Agostino and Pearson test) and for homogeneity of variances (Levene's test) before statistical analyses. To detect differences between two groups, a paired t-test (paired, normal data) with Welch's correction in case of unequal variances, a Mann-Whitney test (unpaired, non-normal data) or a Wilcoxon matched-pairs signed rank test (paired, non-normal data) was analyzed based on Normal test results (d'Agostino-Pearson) and given as variance (f-test) where applicable and with the significance level set to P=0.05 level.

3. Results

The study dimensions were planned to include 200 participants in each group (1,000 total), but was curtailed at n=879 patients because of the Covid-19 pandemic, which reduced surgical capacity. The study inclusion period was 7½ months (November 15, 2020, to June 30th, 2021).

Demographics are given in Table 1.

Figures and tables

Table 1: Demographics, surgery, ASA group, etc., by category.

Group	1. Knee	2. Hip	3. Shoulder	4. Minor Spine	5. Major Spine
n	227	227	70	226	129
Age yr (95%CI)	69.4 (68.3-70.5)	68.8 (67.5-70.2)	59.5 (55.9-63.1)	56.9 (54.7-59.2)	66.9 (64.4-69.4)
Gender (m/f)	109/118	104/123	34/36	127/99	48/81
ASA class 1	12.4%	13.8%	14.5%	22.2%	12.2%
2	65.0%	66.0%	63.6%	58.0%	62.2%
3	22.6%	20.1%	20.0%	19.8%	25.5%
4	0.0%	0.0%	1.8%	0.0%	0.0%
Preoperative NRS Pain Intensity (95%CI)	1.69 (1.38-2.00)	1.99 (1.69-2.29)	2.54 (1.88-3.21)	3.69 (3.33-4.04)	3.21 (2.73–3.69)
Same-Day procedure%	47.7	51.9	48.8	66.2	1.9
General Anesth. %	9.7	4.4	97.1	100.0	100.0
Spinal Anesth. %	92.3	95.6	0.0	0.0	0.0
+ US. -Nerve Block %	71.4	18.6	60.4	0.0	0.0
Ketamine with GA %	0.9	0.0	0.0	1.3	3.9
BIS/Entropy %	0.0	0.0	4.3	39.8	70.5

Overall, 6 of the (N=) 879 included patients (0.68%) scored 2 or greater at Nu-DESC interview at PACU discharge. These were distributed as follows amongst surgical categories; Knee (0%), Hip (2 out of 227 = 0.88%), Shoulder (0 out of 70 = 0%), Minor Lumbar Spine (1 out of 226 = 0.44%), and Major spine (3 out of 129 = 2.3%) (Figure 1). Nu-DESC was higher at PACU admittance than at discharge (Two-tailed probability P < 0,0001; *t*-test; DF=1661). If participants received GA, then it was >5 times more likely that you scored higher Nu-DESC, than if you received regional anesthesia (independent samples t-test; mean GA 0,36 vs. no GA 0,05; P < 0,0001). (Figure 2)

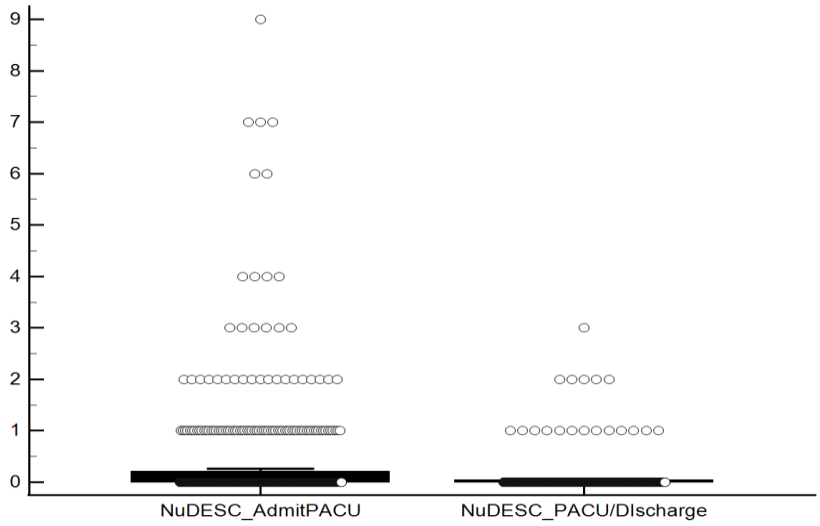

Figure 1: Nu-DESC scores before-after PACU: 35 / 879 (=3.98%) patients scored ≥2 Nu-DESC at PACU-admission, vs. only 6 patients at discharge.

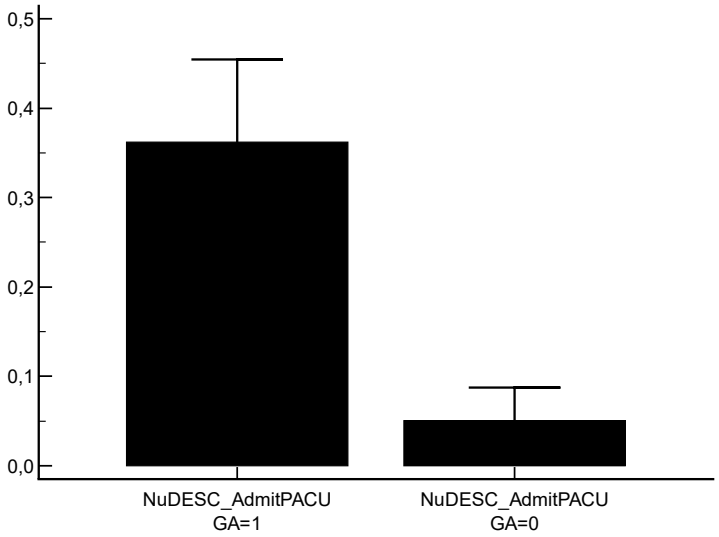

Figure 2: Comparison of Nu-DESC (means ±95CI) at PACU arrival between all patients receiving general anesthesia (GA=1) vs. all patients receiving spinal anesthesia or regional anesthesia alone (GA=0). See text for details.

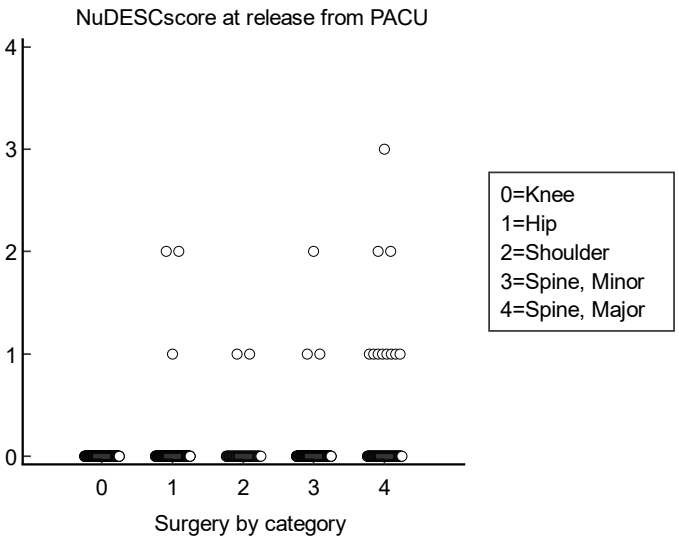

Figure 3: Illustration of single cases of NuDESC ≥2, and NuDESC=1, at PACU discharge across surgical category. This indicates a greater likelihood of delirium risk associated with spine surgery in general anesthesia and lower risk with extremity surgery (and regional anesthesia).

Major spine surgery showed the highest relative frequency of ≥2 NuDESC with 50% of all reported cases (Figure 3). Major spine surgery is renowned for aggravating existing chronic pain problems, but unlike decompression surgery does not provide acute pain relief. This group also had the most GA's and the most instances of Ketamine infusion. These two factors alone most likely can adversely affect Nu-DESC.

Ketamine infusion during GA (and postoperative continuation) did not result in different Nu-DESC at arrival in PACU (P=0.23; two-tailed t-test), but predictably did so at PACU discharge (P<0.0001) as a probable side effect to ketamine.

A two-way anova for PACU-arrival Nu-DESC, which compares *the effect of BIS-monitoring during general anesthesia upon NuDESC,* did not show significant effect of BIS-monitoring upon NuDESC (-BIS NuDESC mean 0.28 vs. +BIS NuDESC mean 0.48; P=0.77; n=442).

Discussion

Our study showed that Nu-DESC score ≥2 at PACU discharge has a low frequency (< 1% overall) in elective, fast-tracked orthopedic surgery, highest in major lumbar spine surgery (2.3% in general anesthesia) and lowest in knee arthroplasty surgery (0.0%) in spinal anesthesia with regional anesthetic nerve blocks. This contrasts with internationally reported rates [2], albeit that these figures may have been over reported historically and taken from a different background. Care should be taken to not directly extrapolate these results to adjacent surgical categories and populations. Lower Nu-DESC scores could be the result of historical improvements in clinical anesthesia provision, different modes of pain management, newer techniques, just to name a few. Furthermore, the cohort presently observed is characterized by the absence of emergency surgery, lack of visceral or intracranial surgery and no septicemia, but also a relatively advanced age in some categories. Moreover, novel anesthetic techniques including shorter acting anesthetic drugs, more regional anesthetic nerve blocks that enable opioid-free (or at least minimal-) have a tendency towards providing less patient discomfort and pain relief, thus avoiding side-effect related disorientation.

Second, the 4% presence of NuDESC ≥2 at PACU arrival, though apparently not an alarmingly high rate, should not cause complacency, rather urge clinicians to further investigate cause and prevention of postoperative dysfunction in the modern era. It has been suggested that the future best be perceived as recovery monitoring through repetitive multidimensional steps that provide clinicians both real-time and retrospective recovery data [3], applied to ever more specialized functions of anesthesia.

The main limitations to this observational study are that it is a highly selected cohort and that it is a single-center study. Conversely, it is quantitatively a significant cohort contribution within that singular clinical area.

Conclusions

Elective orthopedic fast-track surgery does not align well with the generally reported higher incidences of risk of postoperative delirium found in mixed surgeries. It remains speculative, but is suggested from this study, that modern anesthetic techniques including regional anesthesia and nerve blocks, resultant lower opioid usage, better and clearer patient preparation invokes lower delirium risk in the immediate postoperative phase. We should strive to achieve the objective of NuDESC ≤ 1 at PACU arrival and conclusively, much further clinical research is necessary to this end.

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Author contribution: Study concept: JRL, APA, LC. Data acquisition: JRL, CL, HM, INJ, MHS, TV Data collection: HM, CL, HM, INJ, MHS, PKR, TV. Data analysis: JRL, TV. Statistical analysis: JRL Discussion of results: APA, JRL, LC, CR, PKR. Drafting of the manuscript: JRL, APA. Revision of the final manuscript: APA, JRL, LC, HM, CL, INJ, MHS, CR, TV. All authors have read and approved the manuscript.

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