Reducing Post-Operative Delirium and Cognitive Dysfunction: Intraoperative Anesthesia Interventions Guideline

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Abstract

Problem: Post-operative delirium, a common complication in the elderly after surgery, is associated with poor outcomes such as post-operative cognitive dysfunction which is a reduction in cognitive performance following surgery that lasts months after surgery or longer. Implementation of anesthetic interventions can reduce the development of cognitive dysfunction, estimated 40 percent of post-operative delirium cases are preventable using these interventions.

Purpose: The purpose of this quality improvement project was to implement and evaluate tailored anesthesia interventions for surgical patients who screened preoperatively as high risk of developing post-operative delirium/post-operative cognitive dysfunction.

Methods: The project involved patients ≥ 65 years old undergoing surgery at a suburban hospital that screen as high-risk for cognitive dysfunction. Anesthesia providers were educated and demonstrated understanding of the intraoperative anesthesia interventions guideline. Anesthesia providers considered, and when clinically appropriate, provided the interventions in accordance with the guidelines and documented as customary in the patient record. Data regarding the provider's adherence to the guidelines were collected weekly by retrospective chart review.

Results: Of the eligible 345 patients, 217 underwent a cognition screening pre-operatively and 50 screened positive. Anesthesia providers gave consideration to the intraoperative guidelines an average of 96 percent during the project with a range of 50 to 100. On average, the intraoperative guidelines were adhered to 85 percent of the time with a range of 43 to 100.

Conclusions: While the recommended intraoperative care was evidence based and often received consideration, execution of those cares occurred less often. This may have been an oversight on anesthesia providers or due to the contextual nature of intraoperative anesthesia care wherein the recommended guidelines were appropriate in one clinical situation but not another.

Introduction

Post-operative delirium (POD), a common complication in the elderly population after surgery, is associated with numerous poor outcomes such as death, functional decline, prolonged hospital stays, post-operative cognitive dysfunction (POCD), and dementia (Huang et al., 2017). POD describes an acute and fluctuating disturbance of consciousness with reduced ability to focus, maintain, or shift attention, accompanied by change in cognition and perceptual disturbances secondary to a general medical condition (Steinmetz & Rasmussen, 2016). Post-operative cognitive dysfunction is a reduction in cognitive performance following surgery in neurocognitive domains that include attention, verbal memory, and visuospatial abstract that lasts 1-12 months after surgery or longer (Safavynia & Goldstein, 2019). Larger multicenter studies indicate approximately 25.8 percent of elderly patients experience POCD one week after surgery (Huang et al., 2017). Often memory, intellectual performance, and executive functions can be affected, requiring additional monitoring for patients which drive healthcare costs about $150 billion dollars a year according to the University of Rochester Medical Center (2017).

While exact incidence at the project site was unknown, Anesthesia providers at the project site, cognizant of the risk of POD developing into POCD, anecdotally reported elderly patients receiving general anesthesia are most susceptible to POCD. Implementation of anesthetic interventions such as avoiding general anesthesia and utilizing regional anesthesia or monitored anesthesia care reduce the development of POD/POCD which estimated 40 percent of POD cases are preventable using these interventions. Currently, decision-making was at the discretion of each provider, leading to variability in practice and care that may or may not reflect the most current evidence, or current practice allows opportunity for standardization to improve quality and outcomes regarding the anesthetic plan for patients at risk for developing

POD/POCD. Reducing the risk of POD occurrence through specific intraoperative anesthesia interventions would improve quality of care and patient outcomes as well as reduce the preventable increase length of stay and healthcare costs as a result of this operative complication. The purpose of this quality improvement project was to implement and evaluate tailored anesthesia interventions for surgical patients screened preoperatively as high risk for developing POD/POCD. The anticipated outcome of the practice change was 100 percent compliance of anesthesia providers utilizing the intraoperative anesthesia interventions guideline (IAG) for patients who screened preoperatively as high risk of developing POD/POCD (Appendix A).

Evidence Review

In order to promote practice change, research supporting intraoperative interventions and strategies to reduce the risk of developing POD/POCD should be utilized by anesthesia providers to practice in accordance with the best available evidence. The studies included in the body of evidence to underpin the project were all randomized control trials level II evidence with overall B quality rating (Table 1). The use of evidence from randomized controlled trials serve to strengthen the internal validity of the body of evidence to support a practice change (Table 2). The studies provided similar population eligibility and inclusion criteria which focused on patients >65 years old, ASA status 1-3, and for elective surgery. The study settings were all academic university hospital settings and the methodologic consideration of variables being controlled by following stringent intervention fidelity was consistent among all the studies.

Among the level II studies, Edipoglu & Celik (2019) found that utilizing regional anesthesia gave better neurocognitive scores than general anesthesia in patients undergoing total knee arthroplasty. The neurocognitive scores can be linked to reducing the risk of developing POCD. Considering using alternative anesthetic techniques outside of General Anesthesia help

reduce the risk of developing POCD. Hou et al. (2017) found that lighter anesthesia could reduce the rate of POCD with complete analgesia during total knee arthroplasty. Geng et al. (2017) & Li et al. (2015) found that Propofol and Dexmedetomidine anesthesia may be an option for elderly surgical patients compared to inhalational anesthetics. When comparing intravenous anesthetics with inhalational anesthetics sevoflurane and isoflurane on days 1 and 3, the incidence of POCD was markedly reduced by intravenous administration of Propofol or Dexmedetomidine.

Bispectral index (BIS) monitoring was a significant intervention that was researched in 4 out of the 5 studies in the review. Geng et al. (2017), Hou et al. (2017), Li et al. (2015), and Quan et al. (2019) utilized BIS monitoring to measure depth of anesthesia, hypothesizing that depth of anesthesia was associated with POCD. Hou et al. (2017) found that 3.3 percent of participants in the high BIS group developed POCD while low BIS group was 20 percent. Quan et al. (2019) found that utilizing deep anesthesia under total intravenous anesthesia could decrease the occurrence of short-term POCD. The incidence of POCD at 7 days post operatively was 19.2 percent in the deep anesthesia group compared to 39.6 percent in the light anesthesia group. The conflicting data between the studies, may be attributed to the type and length of surgery that was being performed. Both studies recognize depth of anesthesia contribute to reduction of developing POCD. Monitoring depth of the anesthetic allowed providers to tailor their doses of medication and anesthetic plan adequate for the patient. Based on this body of well-designed, well conducted research, and relatively consistent findings, there is a highly level of certainty that this synthesis supports the use of intraoperative anesthesia interventions to reduce the risk of developing POD/POCD.

Theoretical Framework

Lewin's Change theory proposes that individuals are influenced by restraining forces that are countered by driving forces that keep the status quo or utilize the driving forces that push for change to occur (Lewin, 1947). Lewin's Change theory utilizes a step-wise approach and focused on three steps of unfreezing, change, refreezing to influence change. A key requirement to promoting an organizational change requires the staff commitment and involvement because of their participation in the ongoing process and sustainability. Applying Lewin's Change theory to the project under study, anesthesia providers utilized knowledge, skill, and attitude education during the unfreezing stage to adapt to the change (Figure 1). Following up with the anesthesia providers by conducting educational progress meetings whether as a group or individually helped continued use of the IAG.

As the change process began, anesthesia leadership had key involvement in change by the use of incentives such as recognition at team meetings for compliance of identifying at risk patients for developing POD/POCD and utilizing the IAG kept the topic of POD/POCD relevant to the anesthesia providers and allowed leadership to mobilize the team. The change champion acted as a facilitator by acknowledging providers for a job well done and acknowledge their continued efforts for using the IAG. These strategies were needed to continue the engagement of anesthesia providers in the practice change of utilizing the intraoperative interventions for elderly patients at high risk for developing POD/POCD. Lewin's Change Theory confers sustainability through refreezing efforts. Utilizing the mentors or champions of the organization to facilitate the change and continue the process helped sustainability because they remained in this setting in everyday practice. The more that leadership has bought into the practice change, there was an increased likelihood of sustaining the new process because of setting a precedent of learned

behavior. The change champions acted as a facilitator by acknowledging the strength and quality of evidence to support why this intervention is beneficial.

Methods

The setting for this project is a 250-bed, 18 room general operating room (GOR), small community hospital that performs over 10,000 surgeries per year. The target population was patients aged greater than or equal to 65 without a preexisting diagnosis of dementia or Alzheimer's posted for elective surgery, who were high-risk for POD/POCD. Patients who met these criteria who screened positive preoperatively for cognitive impairment using the Mini-Cog Screening Tool were included in the project. The charts of included patients were flagged with a yellow sticker to alert the anesthesia providers of project eligibility. Ethical considerations were followed to ensure the rights of participating patients by decoding information into a case log and included all eligible patients by utilizing the OR schedule to identify patients aged 65 and older, pre-op screened out those with dementia, and screened all remaining patients fitting these criteria (Appendix B).

The implementation team was comprised of a doctoral prepared Academic Faculty Advisor overseeing student implementation, a content expert clinical site representative responsible for site facilitation, and an administrative sponsor & CRNA director sponsor responsible for ongoing project support. Additionally, three change champions responsible for advocating and promoting the project to their anesthesia colleagues, were supported for implementation under the guidance of the Doctor of Nursing Practice Project Lead (DNP-PL). At the start of the quality improvement project, 36 anesthesia providers were trained virtually by the DNP-PL on the new IAG utilizing a voice-over PowerPoint presentation with supplemental print

materials. Anonymized data was collected pre/post training to evaluate learning via a secure encrypted survey, deployed from a web-based platform by the DNP-PL (Appendix C).

The IAG utilized in this project consisted of the following seven practice considerations during surgery for any patient who screened positive on the Mini-Cog Tool preoperatively: use of monitored anesthesia care sedation or regional anesthesia opposed to general anesthesia, use of BIS monitoring 40-60, start low and go slow when administering medications, minimize use of benzodiazepine, ketamine, and narcotics, use of nitrous oxide as inhalational anesthetic, use of Propofol infusion to reduce the use of inhalational anesthetic, and use of dexmedetomidine infusion to reduce the use of inhalational anesthetic.

Anesthesia providers were asked to consider each of these cares during surgery on an eligible patient and document their consideration of performing each practice on the IAG Tool, and document actual care provided in the medical record. Data regarding the provider's consideration of each IAG were collected weekly by the DNP-PL from the IAG Tool, and data regarding the provider's actual intraoperative anesthesia cares was collected by retrospective chart review (Appendix D). Consideration and adherence data were monitored and displayed weekly for the staff through run charts. Strategical adjustments were made based data to improve adherence. The structure goals of this project were achieved included: mobilized the site team, developed evidence-based IAG, virtual staff training at baseline and reinforced via PowerPoint kickoff flyer, fast facts of IAG, and the intraoperative portion of the DNP SRNA project packet (Appendix E). Charts of high-risk patients based on pre-operative screening were flagged as bundle eligible and the anesthesia providers provided guideline cares as clinically appropriate for each patient. Weekly data collection by retrospective chart review to evaluate process measure of

adherence, and strategies to facilitate uptake included weekly huddles, project monitoring, data reporting, positive reinforcement, barrier removal, and gratitude correspondences.

Results

Practice changes by the anesthesia providers in the intraoperative setting were made to influence the outcomes of this quality improvement project. The IAG was a structure implemented for anesthesia providers to utilize in order to reduce the risk of developing POD/POCD. At the start of implementation, 217 out of 345 patients underwent a cognition screening pre-operatively and 50 screened positive. Of those 50 positively screened patients, data was collected on all 50 of those patients. Anesthesia providers utilized the IAG and considered the interventions an average of 96 percent during the project with a range of 50 to 100 (Figure 2). Week 3 was the only week where there was a decrease to 43 percent for consideration of the interventions. Education was provided prior to the start of this quality improvement project and implementation of the new practice process took place over a fourteen-week period. There was a need to re-educate the anesthesia providers when the decrease in considerations occurred and had a marked improvement which demonstrated that the intervention was successful

Adherence to utilizing the IAG was 85 percent, on average, with a range of 43 to 100 (Figure 3). Adherence to utilizing the appropriate interventions at the start of the project was 56 percent and then decreased at 43 percent during week 3. A contributing factor to the decline during week 3 may have been the absence of a project team member on site during that week. Strategies to improve compliance and adherence consisted of education to individual anesthesia providers on a one on one basis and promotion of the readily available education tools strategically placed in the anesthesia lounge for easy reading at the convenience of the anesthesia provider. Again, the re-education sessions provided to the anesthesia providers was a necessary

intervention to improve adherence compliance moving forward. Thereafter, adherence rates increased weekly and by week 9, adherence of the IAG was 100 percent and sustained until the end of implementation

Discussions

This quality improvement project was able to achieve changes in structures and processes at the project site in an effort to impact POD and POCD. Support and buy-in from leadership throughout the project were instrumental to success, as well as the openness from anesthesia providers to change their clinical practice. Leveraging the evidence to support the IAG interventions was a facilitating tactic given the fact that anesthesia is a highly autonomous practice. It is recognized that tracking consideration of the recommended practices fall short of actually changing practice. However, considering changing one's practice is a valuable and essential precursor to actually changing one's practice.

All anesthesia providers were educated on the use of the IAG. Anesthesia providers were receptive to the education and incorporated the IAG in their anesthetic by considerations and actual adherence. Evidence supported by Hou et al. (2017) in which type and depth of anesthesia contribute the development of POD/POCD. Quan et al. (2019) reinforced that monitoring the depth of anesthesia as an intervention contributes to the reduction of overexposure to anesthetics and side effects in order to reduce the risk of developing POD/POCD. The findings of this quality improvement project compare to the evidence-based research publications.

To promote sustainability of this practice change, additional resources would be needed to incorporate the project materials such as the DNP SRNA Project Packet and IAG in the electronic medical record. Kickoff flyers and posters such as The Fast Facts of Intraoperative Anesthesia Interventions Guideline were examples of implementation aids that were used to

serve as visual reminders of the project and stimulate ongoing awareness of the desired practice change. Anesthesia providers noticed the flyer, read the contents, and conversed among each other about anesthetic plans regarding patients at risk for developing POD/POCD which did indeed serve as successful reminders of the project. The fast facts were simple and easy to read. It raised awareness of what were to be considered and to provide a disclaimer that anesthetic plans may not be able to follow the guideline and for the anesthesia provider to follow what was best for the patient. the decision to train the providers using a voice over PowerPoint that was e-mailed was an effective strategy that allow the providers to view the training materials at a time and place that was convenient for them. This provided an opportunity to go through the packet without having the stress of bringing a patient immediately to the OR.

The aim of this project was to change anesthesia provider's practice to incorporate the IAG in their anesthetic plan for patients at high risk for developing POD/POCD. Sustaining this project requires ongoing promotion of the strategies and tactics used to bring about the change. Continued modeling by CRNA leadership and the CSR of the new practice is expected to favorably influence the other anesthesia providers. Feedback provided allowed anesthesia providers to recognize the importance of the intraoperative anesthesia interventions and incorporate these interventions in their anesthetic plan. At this clinical site, changing structures such as new policies or programs, incorporating the IAG into the electronic record or the anesthesia documentation record would be the most influential factor to promote sustainability in the future.

Limitations of this quality improvement project included that all eligible patients may have not have been screened by the preoperative nursing staff. The fact that not all eligible patients were included speaks to an inequity with improving the quality of care and outcomes for

all of the patients who are served by this organization. There are opportunities to better serve those patients who did not receive the benefit of the intervention. There were also patients who were excluded from the project based on cognition, type of surgery, and age, potentially excluding additional patients who might also benefit from these interventions. Additionally, the items of least adherence included Bispectral index monitoring, most likely because of the inconvenience of setting up monitor and utilizing alternative methods to assess anesthetic depth. Providing additional resources to support the use of this technology should be considered to mitigate the inconvenience so as to provide Best practices supported in the literature.

Conclusion

The use of the evidence-based IAG was a feasible initiative to put into practice and proved effective to guide care. The practice change was deemed safe regarding patient care and administration of anesthetics from the anesthesia provider as no untoward events occurred. This practice change is important to health care delivery because the ability to impact POD/POCD in high risk patients has the potential to reduce in the incidence of POD/POCD, impact patient memory, intellectual performance, well-being, and executive functions postoperatively, as well as potential savings in healthcare costs. Anesthesia providers would be interested in these findings because of their interest and duty to continually practice in accordance with the evidence, and the practices described in this project are feasible and easily adoptable.

Implementation in a one on one meeting allows for questions and opinions to be heard individually and provide anesthesia providers an opportunity to understand the considerations versus adherence to the intraoperative anesthesia guidelines. Resistance met when autonomous practice was questioned and clarifying consistently were needed to promote buy-in for the practice change. Executing the process was difficult without establishing a strong planning

process and discussion with anesthesia providers in order to identify the barriers that they were concerned with implementation. Proper preparation as well as continued education and reminders facilitated the best improvement in compliance. Future recommendations for additional work in this area would be to patient evaluation post-discharge to determine the true impact of these initiatives on patient outcomes.

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Table 1

Evidence Review Table

Citation: Edipoglu, I.S. & Celik, F. (2019). The associations between cognitive dysfunction, stress biomarkers, and administered anesthesia type in total knee arthroplasties: Prospective, randomized trial. *Pain Physician, 22,* 495-507.					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
The purpose of this study is to "determine whether the incidence of POCD is associated with the use of general or regional anesthesia in patients undergoing TKA. Our hypothesis was that POCD would be reduced in the group that received regional analgesia without any sedations. Our secondary hypothesis was POCD would be associated with biomarkers of surgical stress (C-reactive protein [CRP], insulin, cortisol, and glucose)".	Randomized controlled study	**Sampling Technique**: Convenience Study conducted at a single-centered university hospital from January to October 2017. **Eligible**: 112 patients having elective unilateral total knee arthroplasty. **Exclusion**: Patients with emergent trauma cases, patients with prior psychiatric or neurologic disorders, patients using steroid medications, chronic nonsteroidal anti-inflammatory drug (NSAID) usage, or patients with uncontrolled diabetes, known difficult intubation. BMI >40, Mini-Mental State Examination (MMSE) score of < 15. **Accepted**: 80/112 patients scheduled for total knee arthroplasty completed preoperative test and were computer randomized into groups. Excluded were: 21/112 failing to meet inclusion criteria and 11/112 declining to participate. **Control**: 46 patients were assigned to the regional anesthesia (RA) group. 31/46	**Control protocol:** Routine GA for TKA involved using 100% oxygen followed by induction with propofol and rocuronium. Anesthesia was maintained with sevoflurane and a mix of 50% O2 and 50% nitrous oxide. **Intervention Protocol:** Routine RA administration involved a single shot of 2.8 mL hyperbaric bupivacaine (0.5%) into the subarachnoid space of the L3-L4 intervertebral space. No use of sedation. **Intervention Fidelity**: Morphine PCA and rescue pain treatment with tramadol and additional morphine. Blood samples were obtained from each patient 15 minutes before anesthesia induction for base results, at the first	**DV:** Development of POCD was defined as any statistically significant change of neurocognitive rest scores from the preoperative levels for each group. **Measure:** MMSE, the Cognitive Failure Questionnaire (CFQ), the Auditory Verbal Learning Test (AVLT), and the Stroop interference test were each administered by an anesthetist 1 day before operation (preoperative), 7 days, and 30 days after operation. No reliability data; No inter-rater reliability documented.	**Statistical Results**: Work data descriptive statistics were calculated for all variables, and normally distributed variables were compared using the Student t test. For nonparametric data, the Mann–Whitney U test was used for group comparisons. To evaluate the follow-up variables that were normally distributed, we employed a repeated measures test with a Bonferroni correction for the binary comparisons. We evaluated the follow-up variables using the Wilcoxon signed-rank test with the Friedman test for binary comparisons. Pearson correlation analysis and Spearman correlation analysis were used to evaluate the interrelationships between variables. *P* values < 0.05 were considered significant. MMSE scores were significantly higher in spinal anesthesia group than the general anesthesia group

		patients were evaluated in the PACU. 15/46 did not receive regional anesthesia due to contraindications such as bleeding risk. **Intervention:** 34 patients were assigned to the general anesthesia (GA) group. 26/34 patients were evaluated in the PACU. 8/34 did not receive general anesthesia due to contraindications with anesthetic. **Power analysis**: Level of significance $\alpha = 0.05$; No power analysis included. **Group Homogeneity**: Intervention groups and control group homogenous based on no significant p values on Table 1 for demographics and clinical characteristics.	intraoperative hour, the third postoperative hour, and the 24th postoperative hour. CRP, cortisol, insulin, and plasma glucose levels were tested. Neurocognitive tests were administered by one of our anesthesiology consultants under the supervision of a psychiatrist. No information on anesthesia providers fidelity.		(p=0.037). Greater change in MMSE score with GA than the RA group between the preoperative evaluation and postoperative day 7 (P = 0.004), and between postoperative day 7 and postoperative day 30 (P = 0.01), which was defined as POCD. General anesthesia group did show higher cortisol levels than the regional anesthesia group at the first hour (P = 0.044). We observed that the spinal anesthesia group showed significantly higher insulin levels at 1 hour intraoperatively than the general anesthesia group (P = 0.019). The general anesthesia group also showed significant glucose measurement variations among the measured timepoints (P = 0.001). **Conclusion:** Patients who undergo arthroplasty surgeries should receive regional anesthesia to avoid POCD. Patients who received regional anesthesia showed lower cortisol, higher insulin, and lower glucose levels. This suggests that lower levels of blood stress markers may be associated with the lower rate of POCD in patients who receive regional anesthesia.

Citation: Geng, Y., Wu, Q., & Zhang, R. (2017). Effect of Propofol, sevoflurane, and isoflurane on postoperative cognitive dysfunction following laparoscopic cholecystectomy in elderly patients: A randomized controlled trial. *Journal of Clinical Anesthesia, 38,* 165-171. http://dx.doi.org/10.1016/j.jclinane.2017.02.007					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
The purpose of this study is "to compare the incidence of POCD in elderly surgical patients receiving different anesthetics and to identify potential biomarkers of POCD in this patient population".	Prospective, randomized, double-blind clinical trial	**Sampling Technique**: Convenience Study conducted at University-affiliated teaching hospital between December 2010 and June 2011. **Eligible**: 200 patients receiving scheduled laparoscopic cholecystectomy at a single site with an ASA score of II-III. **Exclusion**: Allergies to anesthetics, dialysis-dependent renal failure, liver transaminase level <1.5 times normal, Mini-Mental state examination score ≤ 26; schizophrenia or dementia, recent stroke, cognition disorder, mental dysfunction, cerebral surgery, severe anxiety, alcohol abuse, chronic opioid or psychotropic use, age <65. **Accepted**: 150 patients scheduled for laparoscopic cholecystectomy. Computer randomization placed participant into 1/3 groups. **Control**: 50 patients in the Propofol anesthetic group. 50/50 patients were evaluated in the PACU. **Intervention:** 2 groups. 50 patients in the sevoflurane anesthetic group. 50/50 patients were evaluated in the PACU. 50 patients in the isoflurane	**Control protocol**: After induction and intubation, anesthetic maintenance was Propofol infusion. **Intervention protocol:** After induction and intubation, anesthetic maintenance was either inhalational sevoflurane, or inhalational isoflurane. **Intervention fidelity**: No use of premedication, continuous routine monitoring including non-invasive blood pressure, electrocardiogram, oxyhemoglobin saturation (SpO2) and bispectral index (BIS), induction with standard doses of midazolam, fentanyl, rocuronium. Patients were intubated when the BIS decreased to 40–50. Anesthesia on all patients was performed by one anesthesiologist, and a second anesthesiologist, who was blinded to the	**DV**: Development of POCD was defined as a >20% decrease in performance in at least two tests compared at baseline in regards to psychometric and neurocognitive tests. **Measure**: The dependent variable was measured through evaluation by using the MMSE, vision test, Digit symbol substitution test, cumulative test, digit span, trail making test Part A, Rey auditory verbal learning test, and grooved pegboard test. No reliability data; No inter-rater reliability documented.	**Statistical Results**: The Chi-square test was used to compare demographic and clinical characteristics, duration of anesthetics, and operative time. The ANOVA was used to compare the concentration of cytokines in plasma between the differences in the groups. Incidence of POCD in the Propofol group was statistically significant less $p<0.001$, $p=0.012$ than the sevoflurane and isoflurane groups, respectively. **Conclusions**: Propofol anesthesia may be an option for elderly surgical patients compared to sevoflurane or isoflurane.

		anesthetic group. 50/50 patients were evaluated in the PACU. **Power analysis**: 40 participants needed to detect a 60% decrease in the incidence of POCD with a power of 80%. Level of significance of 5% ($\alpha = 0.05$) **Group Homogeneity**: Intervention groups and control group homogenous based on no significant p values on Table 1 for demographics and clinical characteristics.	randomization, evaluated patients' cognitive scores and collected peripheral blood. A third anesthesiologist allocated included patients to 3 groups according to a computer-generated random number table.		
Citation: Hou, R., Wang, H., Chen, L., Qiu, Y., & Li, S. (2017). POCD in patients receiving total knee replacement under deep vs light anesthesia: A randomized controlled trial. *Brain and Behavior, 8,* 1-6. https://doi.org/10.1002/brb3.910					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
The purpose of this study is to "examine the rate of POCD in elderly patients receiving total knee replacement under deep vs. light anesthesia while holding analgesia comparable using nerve block".	Randomized controlled trial	**Sampling Technique**: Convenience Study conducted at Shanghai General Hospital. **Eligible**: 66 patients ASA 1-2, >60 years old scheduled for total knee arthroplasty. **Exclusion**: Severe cardiovascular diseases, diabetes mellitus, neurological or psychiatric illnesses, hepatic and/or kidney dysfunction; regular use of analgesics or antidepressants prior to the surgery; cognitive dysfunction, as defined as Montreal cognitive assessment (MoCA) at <23, prior to the surgery; and inability to comply with the study protocol or procedures. **Accepted**: 66 patients scheduled for total knee arthroplasty	**Control protocol**: BIS monitoring used and HIBIS group-maintained BIS 55-65 **Intervention protocol:** LOBIS group-maintained BIS 40-50. Maintenance anesthetics were adjusted to meet these criteria. **Intervention fidelity**: Prior to induction, femoral and sciatic nerve block performed. Induction with standard doses of midazolam, fentanyl, rocuronium, and propofol. Maintenance of sevoflurane and Propofol infusion.	**DV**: Development of POCD was defined as Z score at >1.96 utilizing the MoCA. **Measure**: The dependent variable was measured through evaluation of cognitive impairment by using MoCA. Utilization of Visual Analogue Scale (VAS) was used to assess pain. No reliability data; No inter-rater reliability documented.	**Statistical Results**: Continuous variables were normally distributed and analyzed with Student's *t* test. Categorical data were analyzed using chi-squared test or Fisher's exact test. POCD occurred in six patients (20%) in the LOBIS group vs. one patient (3.3%) in the HIBIS group ($p = .04$) 1d after the surgery. The VAS pain score did not differ significantly between the two groups at any time point. No subject required additional analgesic. **Conclusions**: In elderly patients undergoing total knee replacement, lighter anesthesia (BIS 55–65) with complete analgesia through

		completed preoperative test and were computer randomized into groups. **Control**: 33 patients were assigned to the HIBIS group. 30/33 patients were evaluated in the PACU. Exclusions included 1/33 withdrew consent and 2/33 failed nerve blockage. **Intervention:** 33 patients were assigned to the LOBIS group. 30/33 patients were evaluated in the PACU. Exclusions included 2/33 withdrew consent and 1/33 failed nerve blockage. **Power analysis**: Level of significance α = 0.05; Power β at 0.80; POCD rate at 41% in the LOBIS group, and clinically meaningful reduction in POCD rate at 15%. The calculation yielded 23 participants per group. **Group Homogeneity**: Intervention groups and control group homogenous based on no significant p values on Table 1 for demographics and clinical characteristics.	Reversal with neostigmine. Blood pressure was managed using a routine protocol. Neuropsychological assessment was conducted at 1d, 3d, and 7d after the surgery using Montreal cognitive assessment (MoCA) by an experienced psychiatrist. The pain was assessed using a 0–10 visual analogue scale (VAS; 0 = no pain and 10 = worst pain imaginable). Postoperative analge-sia was regularly conducted using patient-controlled analgesia (PCA): Sufentanil. No information on anesthesia providers fidelity.		nerve block could decrease the development of POCD.
Citation: Li, Y., He, R., Chen, S., & Qu, Y. (2015). Effect of dexmedetomidine on early postoperative cognitive dysfunction and peri-operative inflammation in elderly patients undergoing laparoscopic cholecystectomy. *Experimental and Therapeutic Medicine*, *10*, 1635-1642. DOI: 10.3892/etm.2015.2726					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
The purpose of this study is to "investigate the effects of dexmedetomidine on early POCD and	Prospective, randomized, placebo-controlled, double-blind clinical trial.	**Sampling Technique**: Convenience Study conducted at Shaoxing People's Hospital in accordance with the guidelines of Good	**Control protocol**: Control group received placebo normal saline infusion. **Intervention protocol:** After induction and	**DV**: Development of POCD was defined as MMSE score reductions of ≥1 ± standard deviation. **Measure**: The	**Statistical Results**: Categorical variables were analyzed using χ^2 or Fisher's exact tests. Continuous variables were tested with Mann Whitney U tests or

inflammatory cytokines in elderly patients undergoing laparoscopic cholecystectomy (LC)".		Clinical Practice between March 2010 and July 2012. **Eligible**: 120 patients ASA 1-3, >60 years old scheduled for LC. **Exclusion**: Patients were aged <60 or >75 years, medical conditions that may affect the level of consciousness, such as stroke, stupor or dementia, abnormalities in hepatic or renal function, preoperative bradycardia [heart rate (HR) <45 bpm] or hypotension [mean arterial blood pressure (MAP) <60 mmHg]; recently received a sedative or opioid drug; Mini Mental State Examination (MMSE) score <24. **Accepted**: 100/120 patients scheduled for laparoscopic cholecystectomy. Patients excluded were: 7/120 refused consent, 5/120 surgery cancelled, 8/120 surgery abandoned. Computer randomization placed the participant into control or intervention group. **Control**: 50 patients in the Propofol anesthetic group. 50/50 patients were evaluated in the PACU. **Intervention:** 50 patients in the sevoflurane anesthetic group. 50/50 patients were evaluated in the PACU. **Power analysis**: No power analysis included. Level of significance of 5% ($\alpha = 0.05$)	intubation, DEX group was given dexmedetomidine bolus then infusion. **Intervention fidelity**: Fasted overnight, no use of premedication, continuous routine monitoring During the investigation, HR, electrocardiography (ECG), MAP, SpO_2 and $PETCO_2$ were continuously monitored. The depth of anesthesia was monitored and recorded by a Bispectral IndexTM(BIS) sensor, induction with standard doses of midazolam, fentanyl, cis-atracurium, and Propofol. Maintenance of sevoflurane, Propofol and remifentanil infusions. Reversal with neostigmine and atropine. The personnel involved in the study, including statisticians, investigators, anesthetists, surgeons and the patients were blinded to the specific	dependent variable was measured through evaluation of cognitive impairment by using MMSE score: <27 indicates cognitive impairment; 21-27, mild cognitive impairment; 9-21, moderate cognitive impairment; and <9, severe cognitive impairment. No reliability data; No inter-rater reliability documented.	Student's t-tests. Repeat analysis of variance compared the difference between the different times in the two groups $P<0.05$. Postoperatively 19 patients in the control group and 9 patients in the DEX group developed mild cognitive impairment ($P=0.026$). When compared with baseline values, the levels of IL-1β, IL-6 and CRP were markedly increased at the 6-h timepoint for patients in the DEX group, while they were increased at 6 h and 1 day following surgery for patients in the control group. **Conclusions**: Dexmedetomidine reduces the incidence of POCD by down- regulating the inflammatory response and may be considered as a method to prevent POCD in elderly patients.

		Group Homogeneity: Intervention groups and control group homogenous based on no significant p values on Table 1 for demographics and clinical characteristics.	experimental scheme implementation.		
Citation: Quan, C., Chen, J., Luo, Y, Zhou, L., He, X., Liao, Y., Chou, J., Guo, Q., Chen, A.F., & Wen, O. (2019). BIS-guided deep anesthesia decreases short-term postoperative cognitive dysfunction and peripheral inflammation in elderly patients undergoing abdominal surgery. *Brain and Behavior, 9,* 1-10. https://doi.org/10.1002/brb3.1238					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
The purpose of this study is to "investigate the incidence of POCD at 7 days and 3 months postoperatively and the association of POCD with anesthesia depth, as defined by BIS under total intravenous anesthesia. This study also investigated some of the relevant biological underpinnings of POCD, and the implications that this may have for clinical management and future investigations".	Randomized parallel controlled clinical trial	**Sampling Technique**: Convenience Study conducted at Third Xiangya Hospital of Central South University between February 2014 to February 2016. **Eligible**: 120 patients aged 60 years or older with ASA 1-2 having planned abdominal surgery under total intravenous anesthesia (TIVA). **Exclusion**: Preexisting neurological or clinically evident neurovascular diseases; mini-mental state examination (MMSE) score <23 before surgery; anticipated difficulty with neuropsychological assessment; associated medical problems that may lead to significant complications; blindness, deafness, Chinese not being first language; drug or alcohol abuse; prior surgery; severe perioperative complication. **Accepted**: 120 patients scheduled abdominal surgery	**Control protocol:** The anesthesia depth in the Deep group was determined by BIS values ranging from 30–45 using Propofol for titration. **Intervention Protocol:** Light group, the anesthesia depth was determined by BIS values ranging from 45 to 60 using Propofol for titration. **Intervention Fidelity**: Total intravenous anesthesia was used during the operation, while induction with propofol, sufentanil, cis-atracurium, and maintenance with propofol and remifentanil. There were no restrictions on the use of muscle relaxants. Neuromuscular	**DV:** Development of POCD was defined by an individual whose postoperative performance deteriorated by 1 or more standard deviations on 2 or more tests. **Measure:** The Mental Control and Digit Span, subtests of the Wechsler Memory Scale, the Halstead-Reitan Trail Making Test (Part A), and the Grooved Pegboard Test. No reliability data; No inter-rater reliability documented.	**Statistical Results**: Group comparisons were made using independent *t* tests for continuous variables, the Mann–Whitney *U* test for ranked data, and chi-square or Fisher exact test for dichotomous data. Correlation analyses were performed using Spearman's rank correlation. The Wald method was used to compute a 95% confidence interval for a proportion. Continuous data were reported as medians (5%–95% percentiles), mean (SD), and proportions indicated by percentages (%). Values of $p < 0.05$, two-tailed, were considered statistically significant in all studies. The incidence of POCD at 7 days after surgery was 19.2% (10/52) in Deep group and 39.6% (21/53) in Light group, being significantly lower in the Deep group ($p = 0.032$).

		under total intravenous anesthesia (TIVA) and were computer randomized into groups. Exclusions include postoperative complications, refused surgery, refused second tests, refused third tests, malignant tumor recurrence, loss contact, and death. **Control**: 60 patients were assigned to the Deep group. 52/60 patients were evaluated in the 7 days after surgery. 39/52 were evaluated 3 months after surgery. **Intervention:** 60 patients were assigned to the Light group. 53/60 patients were evaluated in the 7 days after surgery. 41/53 were evaluated 3 months after surgery. **Power analysis**: Level of significance $\alpha = 0.05$; No power analysis included. **Group Homogeneity**: Intervention groups and control group homogenous based on no significant p values on Table 1 for demographics and clinical characteristics.	blocking agents were used by instructions at the end of surgery. Postoperative analgesia was provided as a standard practice in this department, and depended on surgery type and duration. A blinded observer in the PACU monitored the recovery indexes, such as agitation, extubation time, ARS, RASS, and VAS scores as well as postoperative nausea and vomiting. No information on anesthesia providers fidelity.		However, the different depths of anesthesia had no effect on POCD incidence at 3 months after surgery (10.3% in deep anesthesia group vs. 14.6% in light anesthesia group, (p = 0.558). **Conclusion:** Deep anesthesia, (BIS 30–45), was associated with a reduced incidence of short-term POCD.

Table 2

Synthesis Table

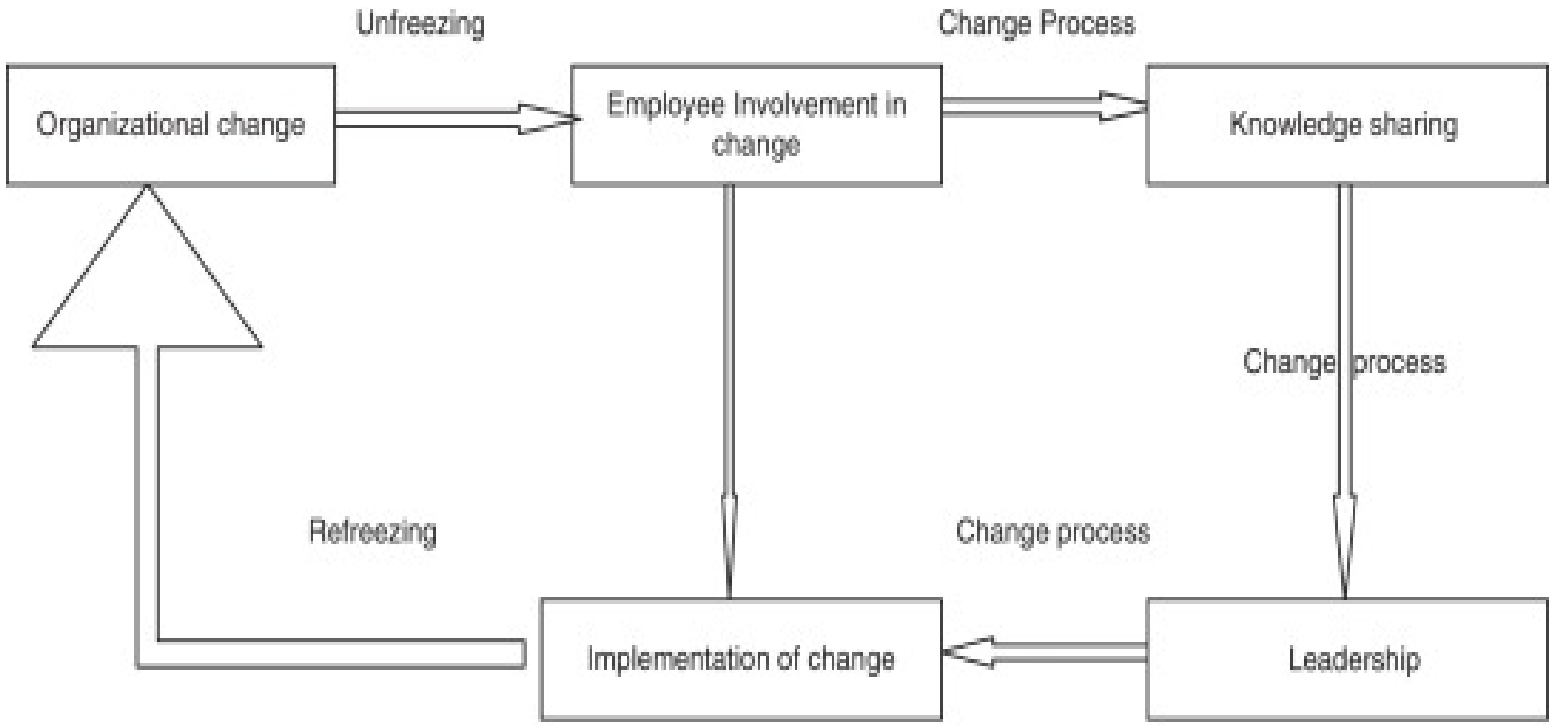
Evidence Based Practice Question (PICO): Does utilizing recommended anesthetic interventions to elderly patients >60 years old reduce the development of Post-Operative Cognitive Dysfunction (POCD) after surgery compared to nonspecific anesthetic interventions based on anesthesia provider preference?			
Level of Evidence	**# of Studies**	**Summary of Findings**	**Overall Quality**
II	**5**	Edipoglu & Celik (2019) found that utilizing regional anesthesia gave better neurocognitive scores than general anesthesia in patients undergoing total knee arthroplasty. The neurocognitive scores can be linked to reducing the risk of developing POCD. Also utilizing biomarkers of surgical stress (CRP, insulin cortisol, and glucose), patients who received regional anesthesia showed lower cortisol, lower glucose, and higher insulin levels. Incidence of POCD was significantly higher for the general anesthesia group at postoperative day 7.	B: The randomized, controlled design strengthens internal validity. The study had no power analysis reported to contextualize the adequacy of the sample size. No evidence of blinding was used besides following protocol for the control and intervention groups. The stringent enrollment criteria may have reduced generalizability, but arguably was useful to control confounding variables. Group homogeneity was present. The use of approved and tested neurocognitive tests provides strength to evaluating POCD. The measures and results were consistent with utilization of many statistical tests to compare the groups but the findings were focused as suggestions and recommendations.
		Geng et al. (2017) found that propofol anesthesia may be an option for elderly surgical patients. Comparing propofol with inhalational anesthetics sevoflurane and isoflurane on days 1 and 3, propofol group incidence of POCD was statistically significant on both days.	B: The adequately powered, double-blind, randomized, controlled design strengthens internal validity. The use of 3 anesthesia providers which 2 were blinded for randomization and data collection, optimized blinding. The stringent enrollment criteria may have reduced generalizability, but arguably was useful to control confounding variables. Group homogeneity was present. The measures and results were consistent. Definitive conclusions that the use of propofol was statistically significant.

		Hou et al. (2017) found that lighter anesthesia could reduce the rate of POCD with complete analgesia during surgery. The use of BIS monitoring allowed to measure the depth of anesthesia and the HIBIS group had 3.3% of participants develop POCD while the LOBIS group had 20%. This study contradicts other studies including Quan et al. which supports deep anesthesia.	B: The adequately powered, randomized, controlled design strengthens internal validity. The study did not incorporate blinding. The sample size needed was 23 participants per group and used 33 participants per group. The stringent enrollment criteria may have reduced generalizability, but arguably was useful to control confounding variables. Group homogeneity was present. The measures and results were consistent.
		Li et al. (2015) found that the using dexmedetomidine during anesthesia decreases the incidence of early POCD due to the reduction of inflammatory response level. The incidence of POCD was markedly reduced by intravenous administration of dexmedetomidine at 20% compared to the placebo group with normal saline at 42%. It was found that the harmful inflammatory mediators of IL-1β, IL-6 and CRP are found to increase incidence of POCD. Levels were attenuated by the administration of dexmedetomidine to elderly patients undergoing LC thus may explain why dexmedetomidine reduces the risk of POCD.	B: The double-blind, randomized, controlled design strengthens internal validity. The use of an active placebo of normal saline in the study optimized blinding. The study was lacking power analysis but the sample size was a moderate number of patients for both control and intervention groups. The stringent enrollment criteria may have reduced generalizability, but arguably was useful to control confounding variables. Group homogeneity was present. The measures and results were consistent.
		Quan et al. (2019) found that utilizing deep anesthesia under total intravenous anesthesia could	B: The blinded, randomized, controlled design strengthens internal validity. The study was lacking power analysis and the small

		decrease the occurrence of short-term POCD. The incidence of POCD at 7 days post operatively was 19.2% in the deep anesthesia group compared to 39.6% in the light anesthesia group. This conflicting data with Hou et al., may be attributed to the type and length of surgery that was being performed.	sample size reduced as number of patients for both control and intervention groups were being excluded. The use of a blinded observer for data optimized blinding. The stringent enrollment criteria may have reduced generalizability, but arguably was useful to control confounding variables. Group homogeneity was present. The measures and results were consistent.

Figure 1

Modified Lewin's Change Theory



Organizational change process showing different stages

Figure 2

Intraoperative Anesthesia Interventions Guideline Completed Considerations Rate

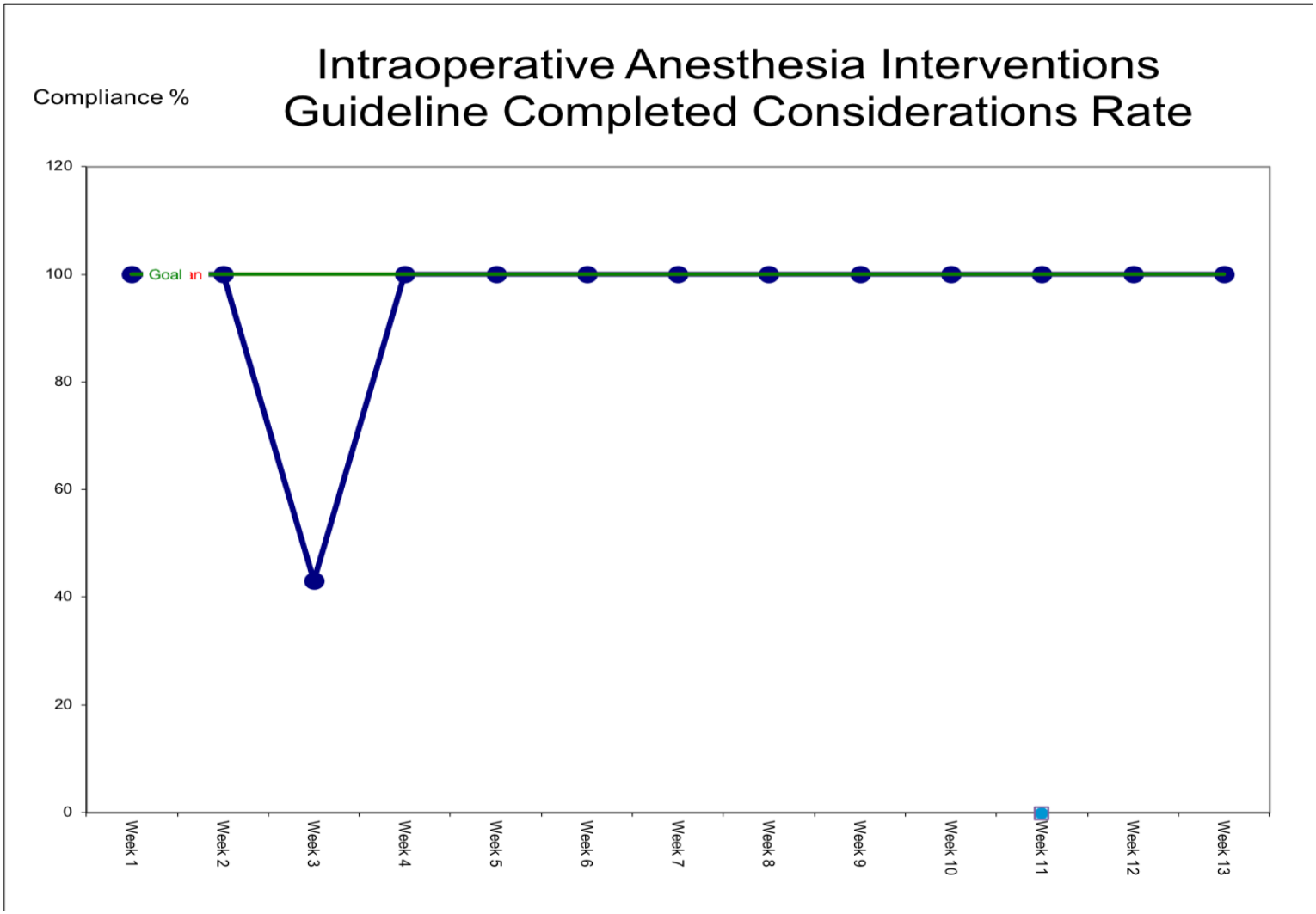
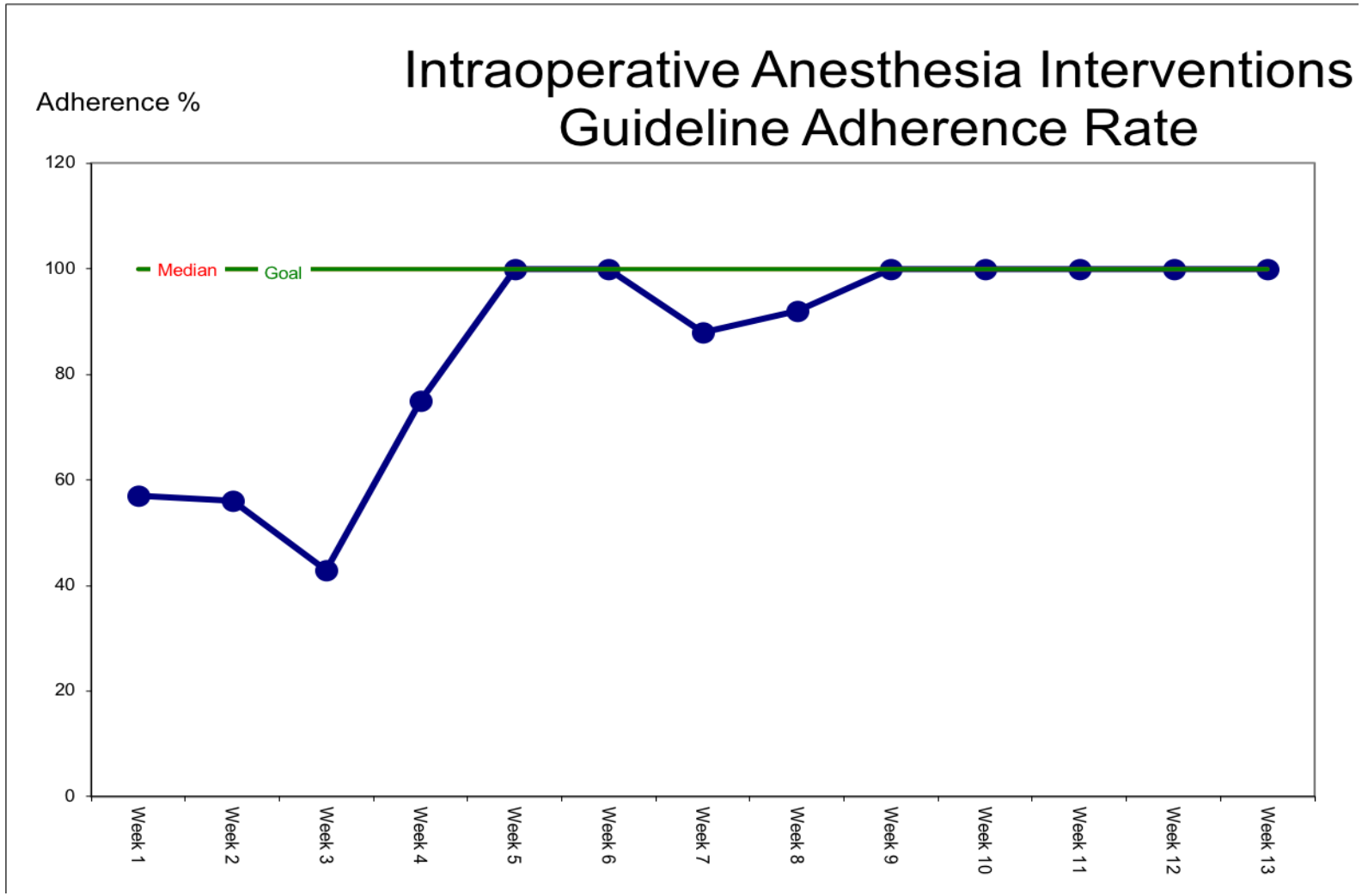


Figure 3

Intraoperative Anesthesia Interventions Guideline Adherence Rate



Appendix A

Intraoperative Anesthesia Interventions Guideline for POD/POCD risk

Intraoperative Anesthesia Interventions Guideline for POD/POCD risk	
Did you consider the following Anesthesia Strategies to prevent POD/POCD	
1. Use of Monitored Anesthesia Care Sedation or Regional Anesthesia	Y/N
2. Use of bispectral index monitoring keeping level between 55-65	Y/N
3. "Start low and go slow" when administering medications	Y/N
4. Minimize use of benzodiazepine, ketamine, and narcotics	Y/N
5. Use of nitrous oxide as an inhalational anesthetic	Y/N
6. Use of Propofol infusion to reduce the use of inhalational anesthetic	Y/N
7. Use of Dexmedetomidine infusion to reduce the use of inhalational anesthetics	Y/N
Comments:	

Appendix B

Case Log

Date	Case Code	Medical Record Number
Week 1	01 02 03	Abc Def ghi
Week 2		
Week 3		
Week 4		
Week 5		
Week 6		
Week 7		
Week 8		
Week 9		
Week 10		
Week 11		
Week 12		
Week 13		
Week 14		
Week 15		

Appendix C

Pre- and Post- Training Survey of Knowledge/Skill/Attitude (KSA)

Pre- and Post- Training Survey

Intraoperative Anesthesia Interventions Guideline for POD/POCD risk

This is an anonymous survey. Please do not respond place your name anywhere on this document. Results will be reported as aggregate.

Please select the statement that you most agree with.

1- Completely disagree
2- Somewhat disagree
3- Neither agree or disagree
4- Somewhat agree
5- Completely agree

1. Anesthesia providers plan of care can reduce the development of POD/POCD.				
1	2	3	4	5
2. I am knowledgeable which patients are identified as high risk for developing POD/POCD.				
1	2	3	4	5
3. I am familiar with different anesthetic interventions that can reduce the development of POD/POCD within my practice.				
1	2	3	4	5
4. Only pharmacological interventions will reduce the development of POD/POCD.				
1	2	3	4	5
5. Adding Intraoperative Anesthesia Interventions Guideline for POD/POCD risk would be detrimental to the workflow in this environment.				
1	2	3	4	5
6. Implementation of Intraoperative Anesthesia Interventions Guideline for POD/POCD risk would be beneficial to patients.				
1	2	3	4	5

Appendix D

Project Data Tracking Tool

Project Data Tracking Tool							
	Case #	**Total # All Patients**	**Total # Eligible Patients**	**Mini-Cog Positive Screen**	**Total # IAG Tools in Chart**	**IAG Considered**	**IAG Adherence**
		>65 years posted on elective surgical schedule	>65 years, elective surgery, w/o Dementia or Alzheimer's	Patients scoring <3 on Mini-Cog screening tool	IAG Tools retrieved from PACU	# of items out of 7 considered	# of items out of 7 performed
Week 1	01						
	02						
	…						
Week 2							
Week 3							
Week 4							
Week 5							
Week 6							
Week 7							
Week 8							
Week 9							
Week 10							
Week 11							
Week 12							
Week 13							
Week 14							
Week 15							

Appendix E

Kickoff Flyer

Perioperative POD/POCD Prevention

Pre-op Nursing Interventions

Mini Cog Screening Tool

Intra-op Anesthesia Interventions

Use of Intraop Condsideration List

Postop Preventive Care Bundle List

(Post op order considerations)

Post-op Nursing Interventions

Postop Preventive Care Bundle List

Fast Facts of Intraoperative Anesthesia Interventions Guideline

Fast Facts

Anesthesia Interventions Guideline for POD/POCD risk

The purpose is to raise awareness of patients at higher risk for POD/POCD development

This guideline is not made to force you to perform these interventions as your anesthetic plan. We understand the autonomy of your practice and that you will continue to provide safe anesthesia for your patient.

The guideline is simply a considerations list to remind anesthesia providers of possible interventions that can be helpful to reduce POD/POCD development

Below are the suggested anesthesia strategies to consider

Intraoperative Anesthesia Interventions Guideline for POD/POCD risk

1. **Use of Monitored Anesthesia Care Sedation or Regional Anesthesia**
2. **Use of bispectral index monitoring keeping level between 55-65**
3. **"Start low and go slow" when administering medications**
4. **Minimize use of benzodiazepine, ketamine, and narcotics**
5. **Use of nitrous oxide as an inhalational anesthetic**
6. **Use of Propofol infusion to reduce the use of inhalational anesthetic**
7. **Use of Dexmedetomidine infusion to reduce the use of inhalational anesthetics**

Postoperative Prevention Care Bundle Checklist

1. **Non-Opiod analgesics for post-op pain management**
2. **Avoidance of anti-psychotics, benzodiazepines, or cholinergic inhibitors for delirium *prophylaxis*.**
3. **Avoidance of medications known to induce delirium in older adults > 65 yo**
4. **Use of antipsychotics (*Haldol*) as first-line treatment for acute POD with agitation**

DNP SRNA Project Packet

POD/POCD Screening Tool & Prevention Guidelines

DNP SRNA Project

University of Maryland, Baltimore

Purpose: The purpose of this project is to reduce the incidence of post-op delirium (POD) and post-op cognitive dysfunction (POCD) in elderly surgical patients (>65 years old). The following recommendations are based off best practice guidelines from the American Geriatrics Society and the American College of Surgeons and is aimed at screening for patients at high-risk for developing POD/POCD pre-operatively and implementing preventive strategies in the OR and PACU settings.

PRE-OP: Please ensure the patient meets the following before proceeding to screening tool.

1. Patient is > 65 years old
2. Scheduled for elective surgery
3. No pre-existing diagnosis of Alzheimer's or dementia in chart

(If any of the following is not met, please circle which one, do not proceed to Mini-Cog screening, and keep the yellow forms in the binder to be returned to PACU box.

ANESTHESIA

Intraoperative Anesthesia Interventions Guideline for POD/POCD risk	
Did you consider the following Anesthesia Strategies to prevent POD/POCD?	
8. Use of Monitored Anesthesia Care Sedation or Regional Anesthesia	Y N
9. Use of bispectral index monitoring keeping level between 55-65	Y N
10. "Start low and go slow" when administering medications	Y N
11. Minimize use of benzodiazepine, ketamine, and narcotics	Y N
12. Use of nitrous oxide as an inhalational anesthetic	Y N
13. Use of Propofol infusion to reduce the use of inhalational anesthetic	Y N
14. Use of Dexmedetomidine infusion to reduce the use of inhalational anesthetics	Y N

What do you know about POD/POCD?

- **Postoperative delirium (POD)** - an acute and fluctuating disturbance of consciousness with reduced ability to focus, maintain, or shift attention, accompanied by change in cognition and perceptual disturbances secondary to a general medical condition.

- **Postoperative cognitive dysfunction (POCD)** - a decline in cognitive function (especially in memory and executive functions) that may last from 1–12 months after surgery, or longer.

- **Post-operative delirium** is the ***most common post-operative complication in the elderly population*** with an incidence of 20-45%

- An estimated **40% of post-op delirium cases are preventable**, however once a patient develops delirium, treatment options are limited and have marginal effects on the duration, severity, and the prevent of recurrent delirium episodes.

- When appropriate, **MAC sedation and regional anesthetics** are preferred over general anesthesia to reduce the risk of developing POD/POCD.

- Use of **Sedline monitoring** is helpful in titration of inhalational anesthetics and minimizing its use.

- POD has been associated with prolonged hospitalizations, decreased functional independence, higher healthcare costs, greater morbidity and mortality, and the development of POCD. Some patients never return to their baseline state and suffer with persistent functional and cognitive deficits after their initial experience with delirium.

- **Benzodiazepines are NOT recommended** for first-line treatment of delirium in the elderly unless related to alcohol or benzodiazepine withdrawal, as it promotes delirium and can even increase the duration of delirium.

- **Anti-psychotics are the recommended first-line treatment** for acute agitated POD in the elderly. Recommended Haldol dosing for elderly patients with acute agitated POD in PACU from the American College of Surgeons (2015): Haldol starting at 0.5 to 1mg PO/IM/IV, re-evaluating in 15 min to 1h and doubling the dose if ineffective.

- **Opioids, benzodiazepines, and diphenhydramine** are identified as medications with highest potential for causing delirium in the elderly.