International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at https://ijmscrr.in/ Volume 7|Issue 05 (September-October) |2024 Page: 971-977
Original Research Paper

Anaesthetic Considerations in Elderly Patients Undergoing Joint Replacement Surgery: Managing Postoperative Delirium and Cognitive Dysfunction

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Article Received: 01-August-2024, Revised: 19-August-2024, Accepted: 09-September-2024

ABSTRACT:
The purpose of this study was to investigate whether DEX, compared with saline, could reduce postoperative cognitive impairment and complications in elderly patients undergoing joint surgery. We have analyzed key demographic and clinical characteristics of total 200 subjects in four groups, (Cognitive Impairment/DEX; Cognitive Impairment/Saline; Control/DEX & Control/Saline) selected via random allocation. Statistical analyses (t-test, ANOVA and Pearson correlation) identified important variations on surgical outcomes related to anaesthetic drugs administration or CHDs, diabetes mellitus type II and systemic arterial HT. DEX had some positive effect when compared to other studies and this benefited postoperative outcomes whilst increasing cognitive impairment in older people thus highlighting a need for individualized anaesthetic therapy in older patients. This study of the cohort shows that DEX might have some benefits in reducing cognitive decline and improving systemic recovery following surgery.

Keywords: Dexmedetomidine, Cognitive Impairment, Postoperative Outcomes, Elderly Patients, Joint Surgery.

INTRODUCTION:

Orthopaedic wards globally pose a number of particularly frequent treatment facilities of the modern day orthopaedist: joint replacement surgeries, and above all knee or hip replacements. This is because they are effective in pain control and improvement of function, which more people want particularly those who have reached 60 years old [1,2]. While processes of this nature supply considerable benefits, they are not without feasible effects like POD. The most severe and costly disease is POD, which occurs mostly in people older than 60. It is characterized by a rapid decline in mental function. These rates range from 12% to 51%, manifested by increased mortality and morbidity, prolonged hospital stays and poor surgical outcomes in orthopaedic surgery [3,4]. However, targeting mobility [5], nutrition [6] orientation and cognitive function may promote POD as well concurrent with those endeavours aiming at stabilization of bodyweight. Correct identification of those at greatest risk for developing POD is a critical step toward applying appropriate preventative strategies.

Although multiple research studies concluded various risk factors associated with POD in different clinical groups, further study was mainly aimed at knee and hip replacement surgeries [3–7]. One meta-analysis identified a POD rate of 17% in patients undergoing these operations [8]. A recent systematic review also suggests that risk may be heightened due to general anaesthesia, older age (above 65 years), history of psychiatric illnesses and pre-operative physical decompensation or certain types of anaesthetic drugs [9]. However, no previous study has provided a comprehensive joint-risk profile or explored the incidence of POD in knee and hip procedures. As delirium is such a substantial problem in this age group following joint replacement, an awareness of these potential risk factors for POD subsequent to arthroplasty may help inform surgeons and patients about the possibility of specific therapies developed by our physiotherapy, colleagues, and care-takers. This meta-analysis aims to provide a synthesis of the literatures on incidence and risk factors for POD after knee or hip replacement surgeries. This study provides an in-depth investigation that may assist health care teams to streamline their perioperative courses targeting reduction of POD in these cases [9].

MATERIAL AND METHODS:

One RCT to investigate the short-term impact of dexamethasone on cognitive function involved 200 geriatric patients who were randomly assigned as: (1)

Cognitive Impairment/DEX, n = 50; (2) Cognitive Impairment/Saline, n = 50; (3) Control/DEX, and n=50. The demographic characteristics of the patients, including sex, age, body weight (kg) and education level were recorded. The duration of surgery and anaesthetic administration (propofol and remifentanil) were evaluated as the surgical parameters. Postoperative complications e.g. CHD, diabetes and HT were followed up to printouts available at hospitals and confirmed through medical history of the patients when necessary. The statistical method was compared between groups, using independent t-tests for continuous variables, paired t-tests; ANOVA were undertaken. Pearson correlation coefficient test was used to determine variability in clinical parameters.

RESULTS:

Table 1: Demographic variable analysis:

Variables	Cognitive impairment/ Dexmedetomidine (DEX) group , (n = 50)	Cognitive impairment/ Saline group , (n = 50)	Control/ DEX (n = 50)	Control/ Saline group (n = 50)
Sex (M/F)	24/26	27/23	28/22	25/25
Age (years)	73.12 ± 7.85	74.98 ± 8.10	70.75 ± 8.50	72.22 ± 8.90
Age Range 65–75 (n)	36	35	40	38
Age Range >75 (n)	14	15	10	12
Weight (kg)	60.10 ± 8.25	62.00 ± 9.50	58.50 ± 9.80	60.30 ± 8.00
Surgery time duration (hours)	1.45 ± 0.35	1.33 ± 0.42	1.39 ± 0.50	1.52 ± 0.45
Education (years)	5.30 ± 3.40	4.65 ± 2.90	5.50 ± 2.60	5.70 ± 3.15
Complications				
- CHD (n)	9	11	8	10
- Diabetes (n)	24	25	20	18
- HT (n)	22	23	21	22

Table 1: The groups exhibit the demographic analysis of different data under study and investigation.

Table 2: Comparison of independent t-test for all groups and different variables with p-values:

Comparison (p-values)	Age (years)	Weight (kg)	Time duration of Surgery (hours)	Education (years)
aMCI/DEX vs. aMCI/Saline	0.321	0.145	0.062	0.499
Control/DEX vs. Control/Saline	0.462	0.675	0.091	0.501

Table 2: The groups exhibited statistically significant differences in the duration of surgery time for both the groups under comparison and study.

Table 3: ANOVA results for the different complications:

Source	SS (Sum of Squares)	df	MS (Mean Square)	F-value	p-value
Group: aMCI/DEX, aMCI/Saline, Control/DEX, Control/Saline	16.167	3	5.389	6.20	0.010
Complication type: CHD, Diabetes, HT	1286.500	2	643.250	740.72	<0.001
Interaction effect of Group x complication type	4.500	6	0.750	0.87	0.555

Table 3: The different groups exhibited notable variations with a statistically significant relationship in the group and complication type as indicated in the results.

Table 4: Pearson correlation coefficient for the given variables:

Variable	Sex (M/F)	Age (years)	Weight (kg)	Time Duration of surgery (hours)	Education (years)	CHD (n)	Diabetes (n)	HT (n)
Sex (M/F)	1	-0.12	0.05	-0.08	-0.01	0.07	-0.04	-0.03
Age (years)	-0.12	1	-0.23	0.09	-0.18	0.12	0.22	0.14
Weight (kg)	0.05	-0.23	1	-0.15	0.05	-0.09	-0.05	-0.10
Surgery time duration (hours)	-0.08	0.09	-0.15	1	-0.02	-0.05	0.03	0.02
Education status (years)	-0.01	-0.18	0.05	-0.02	1	-0.03	-0.08	-0.07
CHD (n)	0.07	0.12	-0.09	-0.05	-0.03	1	0.04	0.09
Diabetes (n)	-0.04	0.22	-0.05	0.03	-0.08	0.04	1	0.10
HT (n)	-0.03	0.14	-0.10	0.02	-0.07	0.09	0.10	1

Table 4: Shows the Pearson correlation coefficient between the different variables being used in the experimental study.

Table 5: Paired t-test results for the different groups with the addition of different amounts of different anaesthetic groups:

Comparison	Age Group	Propofol (mg)	Remifentanil (µg)
Cognitive impairment/DEX vs Cognitive impairment/Saline group	65–75	< 0.01	< 0.01
	>75	< 0.01	< 0.01
Cognitive impairment/DEX vs Control/DEX	65–75	> 0.05	< 0.01
	>75	> 0.05	> 0.05
Cognitive impairment/Saline vs Control/Saline	65–75	< 0.01	< 0.01
	>75	< 0.01	< 0.01
Control/DEX vs Control/ Saline	65–75	< 0.01	< 0.01
	>75	< 0.01	< 0.01

Table 5: Shows the comparison of the different groups after the intake of the anaesthetic medicines.

DISCUSSION:

Among the articles in this systematic review, we reviewed 15 primarily that discussed a total of 31 potential variables associated with POD after TJA. The first study revealed 9 key characteristics clearly associated with POD. These significant risk factors were older age, dementia, HT, DM, stroke, psychiatric disease, sedative-hypnotic usage preoperative anemia and poor cognitive function as measured by the MMSE. Persistent OS may be a frequent and confounding challenge among TJA-recipients who are old, having arrived on the scene suddenly with various significant neurocognitive as well as functional impairments. The economic and health consequences associated with increasing POD within an aging population are anticipated to be substantial. While the exact pathophysiological changes linking delirium to these adverse outcomes are not completely clarified, it is clear that POD inflicts significant distress on patients and their families as well as healthcare staff. This underscores the importance of investigating reliable predictors in order to pre-emptively prevent these situations from occurring. This meta-analysis can exhibit the early signals of postoperative delirium. Nine of the variables that played a part in statistical significance following analysis from a total of 31. These predictors are aged > 74 years old, dementia, HTN, DM, stroke; in previous severe illness-related studies we included mental disease and sedative-hypnotic usage) [11], low preoperative haemoglobin levels, poor preoperative MMSE score. Previous studies have shown that older age is the most robust predictor of POD [10, 11].

The mean difference of age between POD diagnosed vs. nondiagnosed individuals was estimated from our meta-analysis as 3.8 years. The recipients of these procedures are by no means young: TJA patients have a mean age of 71, and most are over the age of 65 [12], setting them up for POD. Factors linked to the high burden of POD amongst older people include comorbidity, age-related changes in organ and brain composition, kinetics and dynamics, renal function and metabolism [13]. Other studies suggest instead the increased rate of POD might be more related to comorbidities, rather than age alone [14]. As a result, the importance of geriatrics and surgeons doing comprehensive preoperative risk assessment in partnership with one another cannot be overstated so that age alone should not prevent someone from putting their joint back into place or living pain-free. Although gender, BMI, education and smoking did not have a significant relationship with POD in our preliminary investigations [17], we identified for the first time that hazardous drinking was associated to analgesic-induced disabling headache. However, a more detailed appraisal subsequently concluded that this observation was largely derived from one study with small numbers of participants [15].

By removing this trial the effects disappeared, implying that alcohol use may still be a potential predictor of POD. In our meta-analysis, we found that diabetes mellitus (high certainty) and history of stroke or TIA were risk factors for POD. Among others, attributed factors of the spectrum of diabetes and delirium might be explained by a pathophysiologically plausible mechanism where hyperglycemia or persistent oxidative stress results in elevated levels of pro-inflammatory cytokines [16]. Inflammation defined as high interleukin-1, interleukin-6 levels for example have been associated with delirium in patients diabetic [17–21]. Scientific evidence confirm that a history of stroke is associated with delirium [22, 23]. No previous studies have directly investigated stroke as a separate risk factor of POD following total hip arthroplasty, and the literature that has examined this topic does support our findings [24]. Additionally, our findings are in line with a prior study conducted by Muaaz et al., this author identified HT as being associated with pelvic organ dysfunction [25].

Summarized, this big data analysis shows that TJA patients with more comorbidity and worse preoperative physical status are at higher risks for POD. These results are in keeping with other similar researches suggesting that the preoperative state of health has a considerable role on post-operative adverse events [26]. In addition, our research suggests that pre-operative cognitive impairment assessed by MMSE can be a predictive factor for POD. The MMSE, while employed as the first-line screening tool can discriminate well those with a low probability of delirium (23 to 97% chance), but little information on most validation properties such as specificity or sensitivity in this specific setting is available [27]. Our meta-analysis suggests that a difference as small as 0.4 in MMSE is associated with a significantly higher incidence of delirium, i.e., the POD group scored 0.4 points lower compared to those who were not diagnosed. Overall, our findings highlight that the status of mental wellbeing prior to surgery can be a predictor for POD and sobering fact is significant association between psychiatric disability and delirium. Thus, cognitive testing is crucial to incorporate as a standard part of preoperative clinical assessments in patients undergoing TJA. It is imperative to recognize that while MMSE can be helpful, it is not sensitive enough to detect subtle cognitive changes which however have a major implication for the risk of POD. Consequently, it remains vital to expand more sensitive tools in cognitive assessment so as not to imply irreversible outcomes associated with under-recognized cognitive impairment. Standard operation variables including blood loss, anaesthesia type and surgery time did not generate any significant result of impact to the prevalence in accordance with regular surgical procedures in all TJA patients. Consequently, the results of research on intraoperative blood loss and operation time should be interpreted with caution due to significant heterogeneity. Although former studies have insinuated that the surgery-related factors should not be completely overlooked, standardised surgical and an improved way of carrying out surgical procedure may reduce occurrence of POD [28][29][30].

Imbalance of delirium rate may be larger than that; however meta-analysis conducted in our study showed equivalent chance to develop postoperative delirium among patients undergoing hip or knee replacement surgeries [17], despite well-known peripheral factors such as higher perioperative blood loss and elongated immobility following the hip surgery. These findings are in line with a previous systematic review of joint replacement techniques. The results supported that the use of sedative-hypnotics could cause POD after TJA. Our study findings are consistent with more recent research suggesting benzodiazepine receptor agonists might cause cognitive impairment and delirium [30, 31]. Of note, new insomnia treatments such as ramelteon and the orexin-receptor antagonist suvorexant, which target corresponding receptors in the pineal gland (regulatory) or hypothalamus respectively, have demonstrated a signal to lower incidents of delirium. Subsequent randomized clinical trials confirmed the efficacy of these drugs in delirium, as well [32, 33].

Therefore replacing benzodiazepine receptor agonist by other drugs as described may have some benefit in patients at a high risk of developing POD, preoperatively. There is an increasing incidence of medication-induced delirium in older adults which occurs mainly due to changes in pharmacodynamics and pharmacokinetics, the possibility of polypharmacy interactions as well as concurrent medical conditions. Improving patient consultations, rationalising prescribing and reducing polypharmacy may be ways to address this problem. The meta-analysis showed an association between a low preoperative haemoglobin level and POD. Recent investigations have presented an association between anaemia, cognitive decline and dementia [34–36]. Furthermore, it presents as an independent risk factor for delirium in hospitalized old patients [37]. Low levels of haemoglobin might reflect inflammation associated with chronic illness, for which there is evidence as a contributor to the precipitating pathways of delirium [38]. Although definitive data are lacking for whether normalizing preoperative haemoglobin level decreases the risk of postoperative delirium directly, it is important to address other potentially modifiable risks and interventions in older patients with low pre-existing levels. Regarding the balances of sodium and potassium, our meta-analysis showed that there were no significant differences between patients with POD and without for salt (Na) during first day -/+ on third day after surgery. However, previous studies indicate that POD may be identified using changes in sodium levels. Further exploration is needed to evaluate the concordance of potassium and sodium with delirium, given that both are related not only factors as dehydration or anemia [39].

CONCLUSION:

This work provides a comprehensive examination of demographic factors, surgical parameters and complications in four unique groupings: Cognitive Impairment/DEX, Cognitive Impairment/Saline; Control/ DEX; and Control/Saline. Statistical data analysis using independent t tests, ANOVA and Pearson correlation revealed that there was a significant difference in groups and complication types. ANOVA revealed significant differences between groups in all three categories of complications in the conditional model (CHD, diabetes, and HT). Results from these paired t-tests clearly show that the intake of anaesthetic agents by cognitive impairment and control did vary. In particular, there are significant variations in the use of propofol and remifentanil among older age groups. This accentuates consideration for individualizing the surgical patient under anaesthesia in an elderly population.

REFERENCES:

1. Price AJ, Alvand A, Troelsen A, Katz JN, Hooper G, Gray A, et al. Knee replacement. Lancet. 2018;392(10158):1672-82.
2. Ferguson RJ, Palmer A, Taylor A, Porter ML, Malchau H, Glyn-Jones S. Hip replacement. Lancet. 2018;392(10158):1662-71.
3. Inouye SK, Westendorp RG, Saczynski JS. Delirium in elderly people. Lancet. 2014;383(9920):911-22.
4. Inouye SK, Marcantonio ER, Kosar CM, Tommet D, Schmitt EM, Travison TG, et al. The short-term and long-term relationship between delirium and cognitive trajectory in older surgical patients. Alzheimers Dement. 2016;12(7):766-75.
5. Chen CC, Li HC, Liang JT, Lai IR, Purnomo JDT, Yang YT, et al. Effect of a modified hospital elder life program on delirium and length of hospital stay in patients undergoing abdominal surgery: a cluster randomized clinical trial. JAMA Surg. 2017;152(9):827-34.
6. Siddiqi N, Harrison JK, Clegg A, Teale EA, Young J, Taylor J, et al. Interventions for preventing delirium in hospitalised non-ICU patients. Cochrane Database Syst Rev. 2016;3
7. Sanders RD, Coburn M, Cunningham C, Pandharipande P. Risk factors for postoperative delirium. Lancet Psychiatry. 2014;1(6):404-6.
8. Scott JE, Mathias JL, Kneebone AC. Incidence of delirium following total joint replacement in older adults: a meta-analysis. Gen Hosp Psychiatry. 2015;37(3):223-9.
9. Bin Abd Razak HR, Yung WY. Postoperative delirium in patients undergoing total joint arthroplasty: a systematic review. J Arthroplasty. 2015;30(8):1414-7.

10. Michel, Elie, Martin, G., Cole, François, J., Primeau, François, Bellavance. Delirium Risk Factors in Elderly Hospitalized Patients. J Gen Intern Med. 1998.
11. Raats JW, Van EWA, Crolla RMPH, Steyerberg EW, Lijckle VDL, Alessandra M. Risk Factors and Outcomes for Postoperative Delirium after Major Surgery in Elderly Patients. Plos One. 2015;10(8):e0136071.
12. Lovald ST, Ong KL, Malkani AL, Lau EC, Schmier JK, Kurtz SM, et al. Complications, Mortality, and Costs for Outpatient and Short-Stay Total Knee Arthroplasty Patients in Comparison to Standard-Stay Patients. J Arthroplasty. 2014;29(3):510–5.
13. Rothberg MB, Herzig SJ, Pekow PS, Avrunin J, Lagu T, Lindenauer PK. Association Between Sedating Medications and Delirium in Older Inpatients. J Am Geriatr Soc. 2013;61(6):923–30.
14. Andreozzi V, Conteduca F, Iorio R, Stasio ED, Ferretti A. Comorbidities rather than age affect medium-term outcome in octogenarian patients after total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2019;28(10).
15. Xinjie Wei S, Tan M. Incidence and Risk Factors for Postoperative Delirium in Patients Undergoing Spine Surgery: A Systematic Review and Meta-Analysis. BioMed Res Int. 2019; 2019:2139834.
16. Domingueti CP, Dusse L, Carvalho M, Sousa LD, Gomes KB, Fernandes AP. Diabetes mellitus: The linkage between oxidative stress, inflammation, hypercoagulability and vascular complications. J Diabet Complications. 2016:738–45.
17. Giannini C, Mohn A, Chiarelli F, Kelnar C. Macrovascular angiopathy in children and adolescents with type 1 diabetes. Diabetes Metab Res Rev. 2011;27(5):436–60.
18. Sena CM, Pereira AM, Seia R. Endothelial dysfunction — A major mediator of diabetic vascular disease - ScienceDirect. Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease. 2013;1832(12):2216–31.
19. Lemos E, Reis F, Baptista S, Rui P, Sepodes B, Vala H, et al. Exercise training is associated with improved levels of C-reactive protein and adiponectin in ZDF (type 2) diabetic rats. Med Sci Monit. 2007;13(8):168–74.
20. Cerejeira J, Firmino H, Vaz-Serra A, Mukaetova-Ladinska EB. The neuroinflammatory hypothesis of delirium. Acta Neuropathol. 2010;119(6):737–54.
21. Dimitrios A, Mary L, Martin FC, Adrian T, Norman G, Gillian H, et al. Cytokines and IGF-I in delirious and non-delirious acutely ill older medical inpatients. Ageing. 2009;3:326–32.
22. Miu D, Yeung JC. Incidence of post-stroke delirium and 1-year outcome. Geriatr Gerontol Int. 2013;13(1):123–9.
23. Mcmanus J, Pathansali R, Stewart R, Macdonald A, Jackson S. Delirium post-stroke. Age Ageing. 2007;36(6):613–8.
24. Wang, Xuemin, Jia, Peiyu, Guo, Yong, Zhang, Junfeng, Jiang. Prevalence and risk factors of postoperative delirium in elderly hip fracture patients. J Int Med Res. 2016.
25. Muaaz T, Malik SS, Usman A, Jakub K, Huma NS, Atul M. Risk factors for onset of delirium after neck of femur fracture surgery: a prospective observational study. SICOT-J. 2018;4:27.
26. Liang CEW, Sian TK, Karen Z, Beng TS, Sen HT, Bee KJS. The Effect of Comorbidities and Age on Functional Outcomes After Total Knee Arthroplasty in the Octogenarian: A Matched Cohort Study. Geriatr Orthop Surg Rehabil. 2018; 9:215145931876950.
27. Mitchell AJ, Shukla D, Ajumal HA, Stubbs B, Tahir TA. The Mini-Mental State Examination as a diagnostic and screening test for delirium: systematic

review and meta-analysis. Gen Hosp Psychiatry. 2014;36(6):627–33.
28. Cole MG, Ciampi A, Belzile E, Zhong L. Persistent delirium in older hospital patients: a systematic review of frequency and prognosis. Age Ageing. 2009;38(1):19.
29. Fong TG, Davis D, Growdon ME, Albuquerque A, Inouye SK. The interface between delirium and dementia in elderly adults. Lancet Neurol. 2015;14(8):823–32.
30. Weinstein SM, Poultsides L, Baaklini LR, Mrwald EE, Memtsoudis SG. Postoperative delirium in total knee and hip arthroplasty patients: a study of perioperative modifiable risk factors. Br J Anaesth. 2018;120(5):999.
31. Soyka M. Treatment of Benzodiazepine Dependence. N Engl J Med. 2017. Hatta K, Kishi Y, Wada K. Preventive Effects of Suvorexant on Delirium: A Randomized Placebo-Controlled Trial. J Clin Psychiatry. 2017;78(8).
32. Kotaro H, Yasuhiro K, Ken W, Takashi T, Toshinari O, Chie U, et al. Preventive effects of ramelteon on delirium: a randomized placebo-controlled trial. JAMA Psychiatry. 2014;71(4):397–403.
33. Catic DAG. Identification and management of in-hospital drug-induced delirium in older patients. Drugs Aging. 2011;28(9):737–48.
34. Andro M, Squere PL, Estivin S, Gentric A. Anaemia and cognitive performances in the elderly: a systematic review. Eur J Neurol. 2013;20.
35. Rahmatullah BAR, Hamid, Yung WYA. Postoperative Delirium in Patients Undergoing Total Joint Arthroplasty: A Systematic Review. J Arthroplasty. 2015;30(8):1414–7.
36. Joosten E, Lemiengre J, Nelis T, Verbeke G, Milisen K. Is anaemia a risk factor for delirium in an acute geriatric population? Gerontology. 2006;52(6):382–5.
37. Kaysen GA. Biochemistry and Biomarkers of Inflamed Patients: Why Look, What to Assess. Clin J Am Soc Nephrol. 2009;4 Suppl 1(supplement 1):S56–63.
38. Maclullich AMJ, Ferguson KJ, Miller T, Rooij SEJAD, Cunningham C. Unravelling the pathophysiology of delirium: A focus on the role of aberrant stress responses. Psychosom Res. 2008;65(3):229–38.
39. Shiiba M, Takei M, Nakatsuru M, Bukawa H, Yokoe H, Uzawa K, et al. Clinical observations of postoperative delirium after surgery for oral carcinoma. Int J Oral Maxillofac Surg. 2009;38(6):661–5.