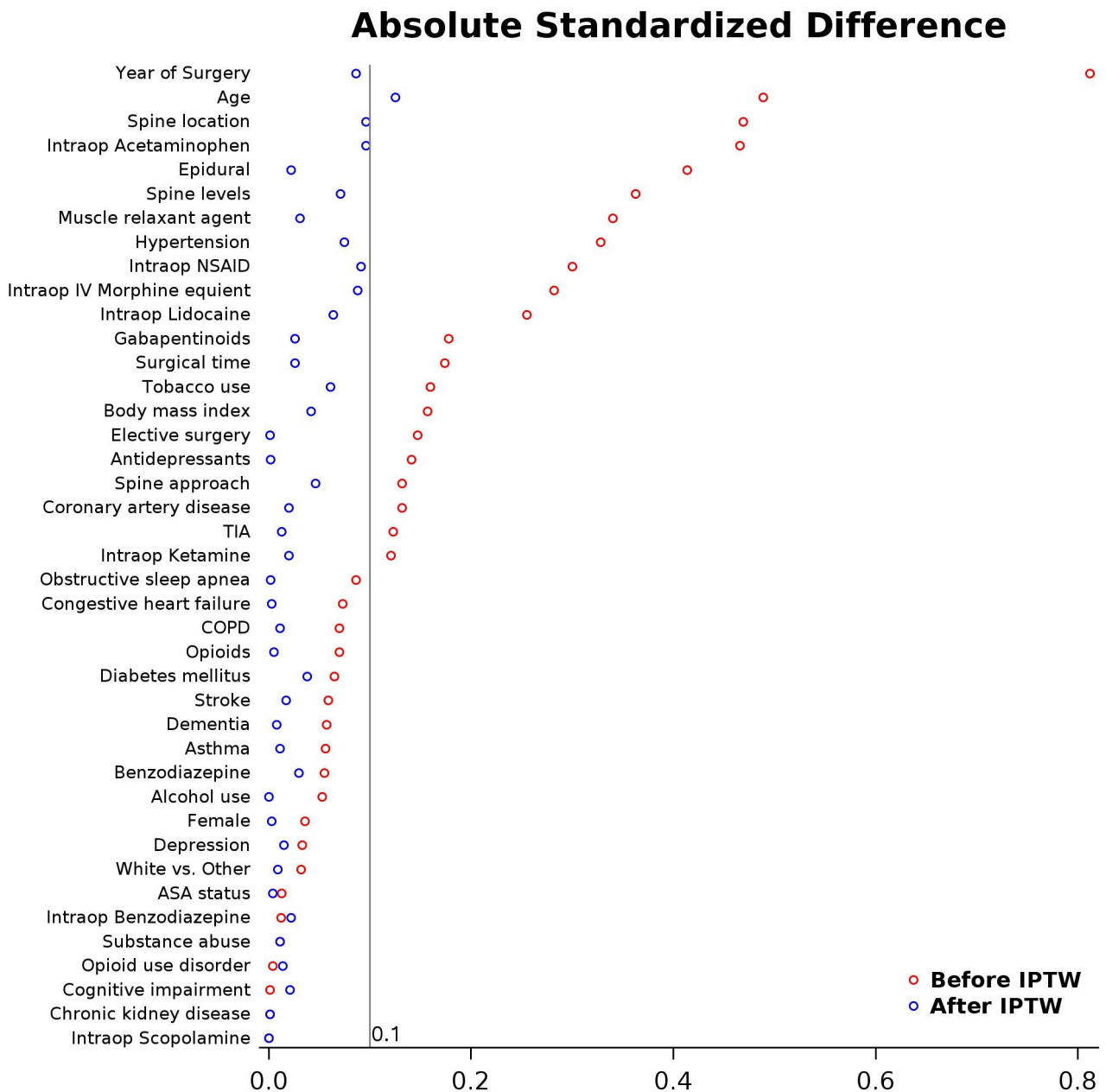
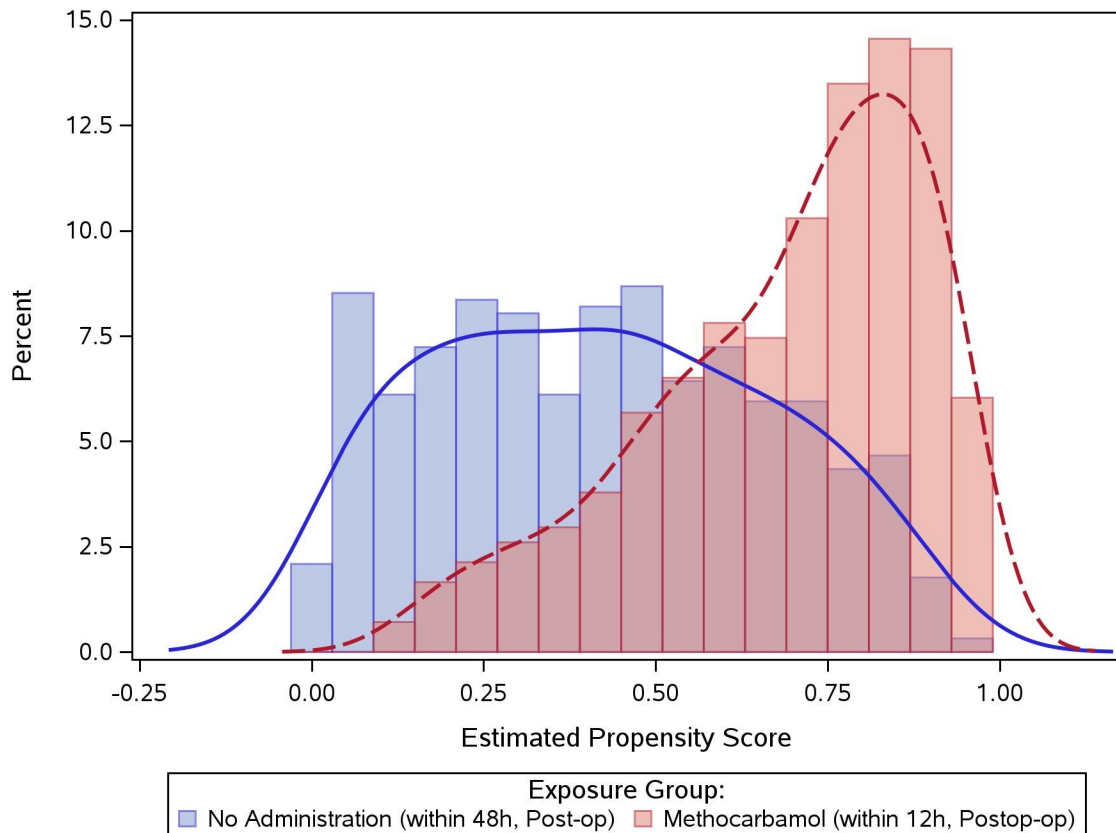


Supplemental Digital Content

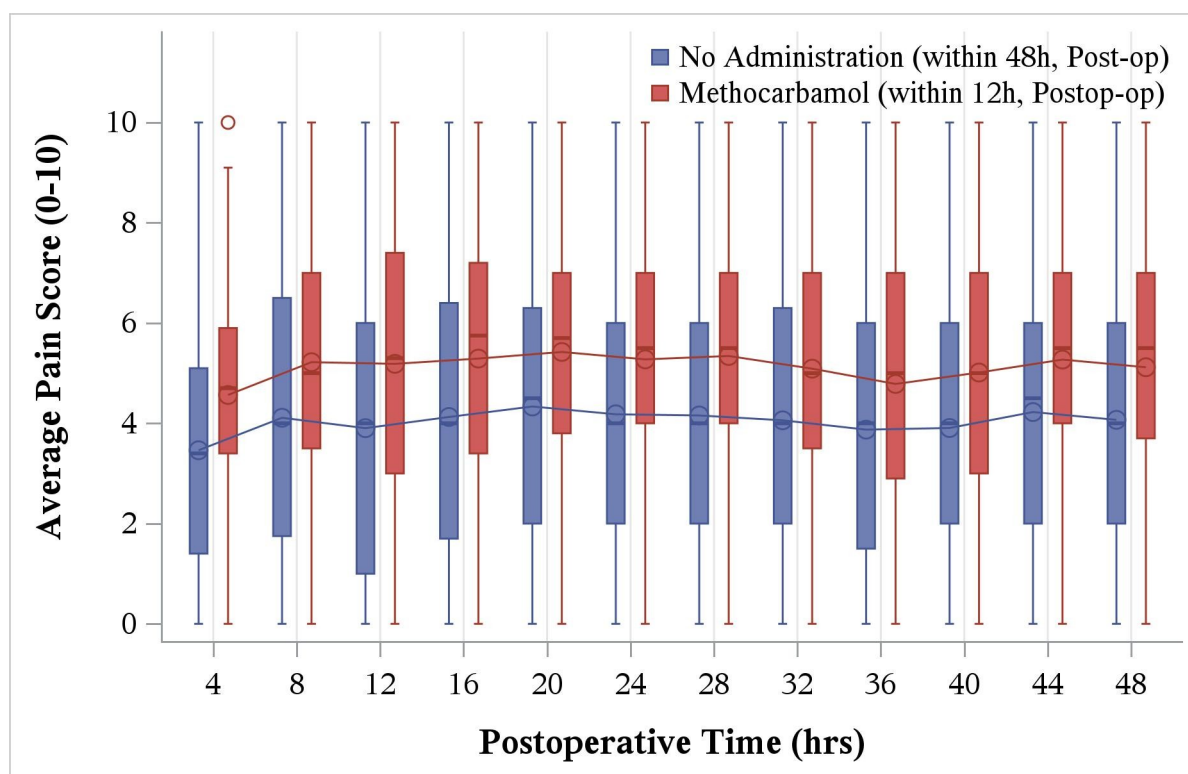
Association between postoperative methocarbamol and postoperative pain opioid dose requirements in patients undergoing extensive spine fusion surgery: a retrospective cohort study



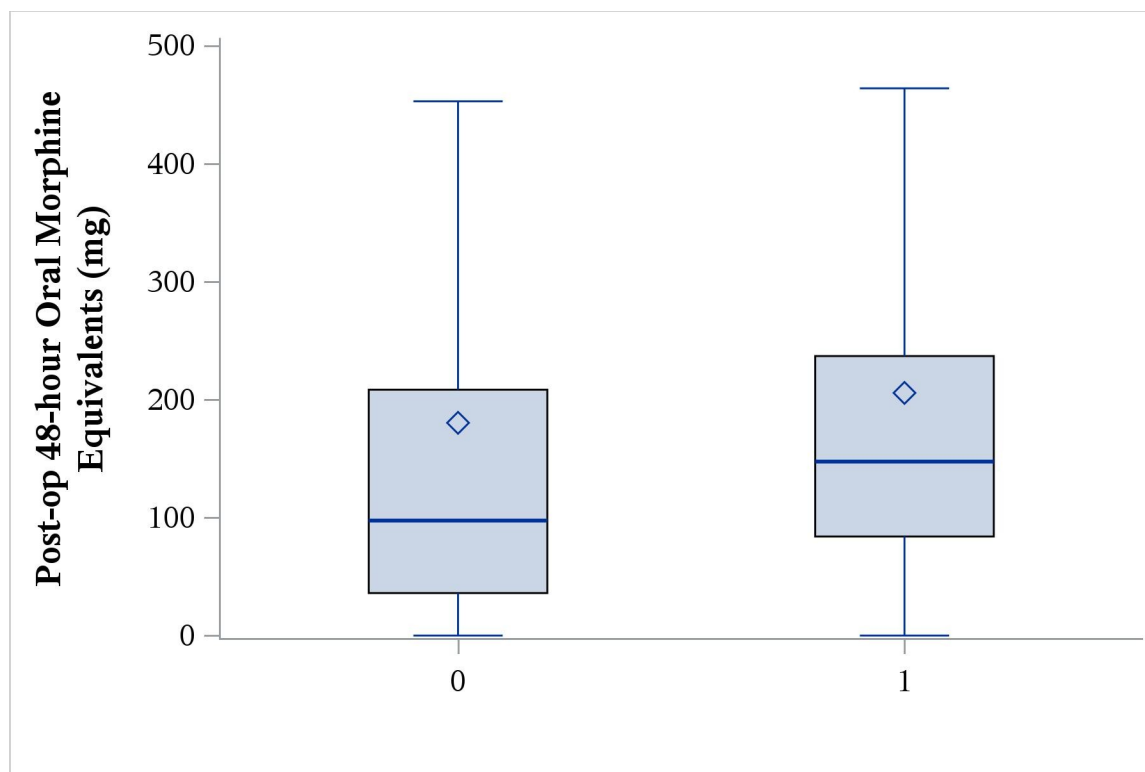
Appendix Figure 1. Absolute standardized differences for baseline covariates before and after inverse probability of treatment weighting (IPTW), comparing patients who received Methocarbamol within 12 hours postoperatively versus those with no Methocarbamol use within 48 hours postoperatively. The vertical reference line at 0.1 indicates the conventional threshold for acceptable covariate balance. After weighting, most covariates were well balanced except for age which was adjusted for in the multivariable analysis.



Appendix Figure 2. Histograms of the estimated propensity scores from the multivariable logistic regression. It showed good overlap between groups (69% overlap).



Appendix Figure 3. Comparison of postoperative pain trajectories between patients receiving methocarbamol (red) and those not receiving administration (blue). Data are presented as box plots (interquartile range and whiskers) with connected mean values. Patients in the methocarbamol group reported higher baseline and sustained pain scores through 48 hours



Appendix Figure 4. Cumulative 48-hour Oral Morphine Equivalents (mg). Comparison of opioid requirements between the control group and the methocarbamol group. The box represents the interquartile range (IQR), the central line denotes the median, and the diamond represents the mean. Whiskers show the full range of data excluding outliers, which have been omitted from this visualization

Appendix Table 1. Estimation of FIO₂, the type of device and the oxygen flow rate

Method	O ₂ flow (l/min)	Estimated FiO ₂ (%)
Nasal cannula	1	24
	2	28
	3	32
	4	36
	5	40
	6	44
Face mask	5	40
	6-7	50
	7-8	60
Face mask with reservoir	6	60
	7	70
	8	80
	9	90
	10	95

Appendix Table 2. Baseline Characteristics and Surgical Factors by Methocarbamol Use vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol (N=1437)	No use (N=622)	Unadjusted ASD †	ASD after IPTW †
Age, years	66 ± 11	59 ± 20	0.470	0.035
Female -no %	739 (51)	304 (49)	0.051	0.012
White – no %	1,241 (86)	537 (86)	0.001	0.005
Body mass index ^a , kg/m ²	30 ± 6.2	29 ± 6.9	0.148	0.019
Medical history – no. %				
Depression	508 (35)	211 (34)	0.030	0.012
Tobacco use	784 (55)	292 (47)	0.153	0.038
Substance abuse	170 (12)	75 (12)	0.007	0.015
Alcohol use	83 (5.8)	32 (5.1)	0.028	-0.010
Opioid use disorder	103 (7.2)	47 (7.6)	0.015	0.026
Chronic Obstructive Pulmonary Disease	362 (25)	141 (23)	0.059	0.020
Asthma	230 (16)	89 (14)	0.047	0.002
Obstructive sleep apnea	427 (30)	160 (26)	0.089	0.005
Hypertension	1,119 (78)	402 (65)	0.296	0.047
Congestive heart failure	138 (9.6)	81 (13)	0.108	0.007

Appendix Table 2. Baseline Characteristics and Surgical Factors by Methocarbamol Use vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol (N=1437)	No use (N=622)	Unadjusted ASD †	ASD after IPTW †
Coronary artery disease	361 (25)	130 (21)	0.100	0.008
Diabetes mellitus	428 (30)	170 (27)	0.054	0.001
Stroke	138 (9.6)	70 (11)	0.054	0.014
Transient ischemic attack	101 (7.0)	30 (4.8)	0.094	0.012
Chronic kidney disease	292 (20)	125 (20)	0.006	0.009
Cognitive impairment	253 (18)	116 (19)	0.027	0.025
Dementia	24 (1.7)	18 (2.9)	0.082	0.001
Preoperative medications – no. %				
Opioids	601 (42)	242 (39)	0.059	0.013
Benzodiazepine	234 (16)	120 (19)	0.079	0.034
Antidepressants	599 (42)	221 (36)	0.127	0.008
Gabapentinoids	646 (45)	239 (38)	0.133	0.033
Muscle relaxant agent	480 (33)	129 (21)	0.288	0.025
Surgical parameters				
Spine location			0.439	0.073
Cervical	229 (16)	69 (11)		
Thoracic	98 (6.8)	88 (14)		
Lumbar	365 (25)	75 (12)		
Combined	745 (52)	390 (63)		
Spine approach			0.122	0.044
. Anterior	84 (5.9)	29 (4.7)		
. posterior	1,140 (80)	519 (84)		
. both	206 (14)	67 (11)		
Spine levels ^b	4.0 [3.0, 7.0]	5.0 [4.0, 7.0]	0.329	0.040
ASA status			0.025	0.033
1	4 (0.28)	23 (3.7)		
2	150 (10)	80 (13)		
3	1,111 (77)	398 (64)		
4	171 (12)	120 (19)		
5	1 (0.07)	1 (0.16)		
Elective surgery	1,299 (90)	525 (84)	0.181	0.012
Surgical minutes	369 ± 129	385 ± 138	0.122	0.002

Appendix Table 2. Baseline Characteristics and Surgical Factors by Methocarbamol Use vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol (N=1437)	No use (N=622)	Unadjusted ASD †	ASD after IPTW †
Epidural analgesia	747 (52)	247 (40)	0.248	0.058
Intraoperative medications				
Acetaminophen	43 (3.0)	99 (16)	0.453	0.058
Nonsteroidal Anti-inflammatory Drugs	107 (7.4)	90 (14)	0.226	0.070
Ketamine	250 (17)	147 (24)	0.155	0.009
Lidocaine	1,389 (97)	564 (91)	0.248	0.026
Benzodiazepine	664 (46)	290 (47)	0.008	0.027
Scopolamine	0 (0.0)	0 (0.0)	0	0
Oral Morphine equivalent, mg	99 [60, 261]	168 [69, 393]	0.256	0.045
Year of surgery			0.570	0.084
2018	175 (12)	147 (24)		
2019	219 (15)	132 (21)		
2020	170 (12)	120 (19)		
2021	187 (13)	86 (14)		
2022	244 (17)	66 (11)		
2023	249 (17)	39 (6.3)		
2024	193 (13)	32 (5.1)		

Summary statistics (presented as % of patients, mean $\pm$ SD, or median [Q1, Q3], respectively, for factors, symmetric continuous variables, and skewed continuous variables; ASA = Physical Status Classification System

* IPTW = inverse probability of treatment weighting: First, we estimated the probability of receiving methocarbamol within 12-hours postoperatively (i.e., the propensity score) for each patient using logistic regression with receiving methocarbamol as the outcome using the following pre-specified potential confounding variables (listed in Table 1). Then, we calculated the stabilized weights as follows: for the methocarbamol group, weight was the proportion of methocarbamol patients divided by the propensity score; for the control group who did not received methocarbamol within 48-hours postoperatively, weight was the proportion of non-methocarbamol patients divided by (1- propensity score). To be conservative, we also truncated the stabilized weights at 1st and 99th percentiles.

†Absolute standardized difference: absolute difference in means or proportions divided by the pooled standard deviation after weighting each observation with IPTW. Any covariables with an ASD > 0.10 were imbalanced and would be adjusted for in the analysis.

^{a and b} presented 35 and 14 missing data points.

Appendix Table 3. Baseline Characteristics and Surgical Factors by Methocarbamol Use >2000mg vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol $\geq$		Unadjusted ASD $\ddagger$	ASD after IPTW $\ddagger$
	2000mg (N=1063)	No use (N=622)		
Age, years	65 $\pm$ 11	59 $\pm$ 20	0.404	0.075
Female -no %	542 (51)	304 (49)	0.042	0.019
White – no %	917 (86)	537 (86)	0.002	0.008
Body mass index ^a , kg/m ²	30 $\pm$ 6.3	29 $\pm$ 6.9	0.163	0.039
Medical history – no. %				
Depression	381 (36)	211 (34)	0.040	0.002
Tobacco use	590 (56)	292 (47)	0.172	0.049
Substance abuse	135 (13)	75 (12)	0.019	0.005
Alcohol use	67 (6.3)	32 (5.1)	0.050	0.011
Opioid use disorder	80 (7.5)	47 (7.6)	0.001	0.020
Chronic Obstructive Pulmonary Disease	258 (24)	141 (23)	0.038	0.008
Asthma	163 (15)	89 (14)	0.029	0.007
Obstructive sleep apnea	314 (30)	160 (26)	0.085	0.013
Hypertension	820 (77)	402 (65)	0.278	0.059
Congestive heart failure	97 (9.1)	81 (13)	0.124	0.008
Coronary artery disease	252 (24)	130 (21)	0.067	0.001
Diabetes mellitus	306 (29)	170 (27)	0.032	0.013
Stroke	91 (8.6)	70 (11)	0.090	0.007
Transient ischemic attack	71 (6.7)	30 (4.8)	0.080	0.021
Chronic kidney disease	192 (18)	125 (20)	0.052	0.011
Cognitive impairment	194 (18)	116 (19)	0.010	0.023
Dementia	18 (1.7)	18 (2.9)	0.080	0.004
Preoperative medications – no. %				
Opioids	448 (42)	242 (39)	0.066	0.007
Benzodiazepine	174 (16)	120 (19)	0.076	0.034
Antidepressants	443 (42)	221 (36)	0.126	0.002
Gabapentinoids	488 (46)	239 (38)	0.152	0.033
Muscle relaxant agent	380 (36)	129 (21)	0.338	0.038
Surgical parameters				
Spine location			0.415	0.082
Cervical	182 (17)	69 (11)		

Appendix Table 3. Baseline Characteristics and Surgical Factors by Methocarbamol Use >2000mg vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol $\geq$		Unadjusted ASD $\ddagger$	ASD after IPTW $\ddagger$
	2000mg (N=1063)	No use (N=622)		
Thoracic	71 (6.7)	88 (14)		
Lumbar	246 (23)	75 (12)		
Combined	564 (53)	390 (63)		
Spine approach			0.130	0.043
. Anterior	68 (6.4)	29 (4.7)		
. posterior	841 (79)	519 (84)		
. both	150 (14)	67 (11)		
Spine levels ^b	4.0 [3.0, 7.0]	5.0 [4.0, 7.0]	0.309	0.045
ASA status			0.040	0.022
1	3 (0.28)	23 (3.7)		
2	116 (11)	80 (13)		
3	821 (77)	398 (64)		
4	122 (11)	120 (19)		
5	1 (0.09)	1 (0.16)		
Elective surgery	960 (90)	525 (84)	0.178	0.002
Surgical minutes	365 $\pm$ 130	385 $\pm$ 138	0.145	0.012
Epidural analgesia	573 (54)	247 (40)	0.287	0.034
Intraoperative medications				
Acetaminophen	30 (2.8)	99 (16)	0.461	0.081
Nonsteroidal Anti-inflammatory Drugs	73 (6.9)	90 (14)	0.248	0.066
Ketamine	193 (18)	147 (24)	0.135	0.010
Lidocaine	1,029 (97)	564 (91)	0.255	0.053
Benzodiazepine	515 (48)	290 (47)	0.037	0.028
Scopolamine	0 (0.0)	0 (0.0)	0	0
Oral Morphine equivalent, mg	99 [60, 255]	168 [69, 393]	0.255	0.063
Year of surgery			0.642	0.081
2018	115 (11)	147 (24)		
2019	158 (15)	132 (21)		
2020	113 (11)	120 (19)		
2021	131 (12)	86 (14)		
2022	191 (18)	66 (11)		

Appendix Table 3. Baseline Characteristics and Surgical Factors by Methocarbamol Use >2000mg vs. No Use within 48 Hours After Surgery, Before and After Inverse Probability of Treatment Weighting (IPTW)*

Factor	Methocarbamol $\geq$		Unadjusted ASD †	ASD after IPTW †
	2000mg (N=1063)	No use (N=622)		
2023	202 (19)	39 (6.3)		
2024	153 (14)	32 (5.1)		

Summary statistics (presented as % of patients, mean $\pm$ SD, or median [Q1, Q3], respectively, for factors, symmetric continuous variables, and skewed continuous variables; ASA = Physical Status Classification System

* IPTW = inverse probability of treatment weighting: First, we estimated the probability of receiving methocarbamol within 12-hours postoperatively (i.e., the propensity score) for each patient using logistic regression with receiving methocarbamol as the outcome using the following pre-specified potential confounding variables (listed in Table 1). Then, we calculated the stabilized weights as follows: for the methocarbamol group, weight was the proportion of methocarbamol patients divided by the propensity score; for the control group who did not received methocarbamol within 48-hours postoperatively, weight was the proportion of non-methocarbamol patients divided by (1- propensity score). To be conservative, we also truncated the stabilized weights at 1st and 99th percentiles.

†Absolute standardized difference: absolute difference in means or proportions divided by the pooled standard deviation after weighting each observation with IPTW. Any covariables with an ASD > 0.10 were imbalanced and would be adjusted for in the analysis.

^a and ^b presented 29 and 11 missing data points.