Risk Factors for Hypotension within 24 Hours after Operations in Patients Receiving Epidural Analgesia

Sukanya Dejarkom, M.D., Suwannee Suraseranivongse, M.D., Vimolluck Sanansilp, M.D., Taniga Kiatchai, M.D., Praewpan Jongsaengtong, M.D.

Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

ABSTRACT

Objective: Post-operative analgesia is imperative to prevent post-operative complications. Epidural analgesia provides effectiveness superior to systemic analgesia, but might be complicated with motor block or hypotension. The aim of this study was to identify risk factors related to hypotension within 24 hours after operations in patients receiving epidural analgesia.

Methods: A case-control study was conducted in 60 case patients and 240 control patients. Patient, surgical and anesthetic risk factors were collected. Patient factors included body mass index, pre-operative blood pressure, ASA classification, underlying diseases, current medications, bowel preparation, intravenous fluid replacement after fasting, and pre- and post-operative anemia. Surgical factors were operation for malignancy, operative time, blood loss, blood transfusion and urine output status. Anesthetic factors including choice of anesthesia, site of epidural catheter and its appropriateness, agents administered via epidural route, post-operative patient-controlled epidural analgesia use, additional systemic analgesia, and agents administered were recorded. Univariate and multiple logistic regression analysis were used to identify risk factors.

Results: The probability of hypotension increased in patients with coronary artery disease (odds ratio (OR) = 6.36, 95% Confidence interval (CI) = 1.38, 29.33) and post-operative anemia with hemoglobin concentration less than 10 gm/dL (OR = 4.13, 95% CI = 2.03, 8.43). The other factors showed no correlations with hypotension. No serious consequences occurred in hypotensive patients.

Conclusion: Risk factors associated with hypotension within 24 hours after operations in patients receiving epidural analgesia were coronary artery disease and post-operative hemoglobin less than 10 gm/dL.

Keywords: Epidural analgesia, post-operative hypotension, risk factor

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INTRODUCTION

Post-operative analgesia is imperative to prevent significant complications, such as post-operative pulmonary complications, decrease length of hospital stay and cost reduction. Analgesic drugs could be administered with peripheral nerve blockade, systemic route or epidural catheter. Many studies showed that epidural analgesia provided effectiveness superior to systemic analgesia.[1,2] However, epidural analgesia might be complicated with nausea, vomiting, pruritus, high block, motor block, hypotension, alteration of consciousness,

Correspondence to: Sukanya Dejarkom
E-mail: aun198@yahoo.com
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respiratory depression and spinal hematoma.[3-6] The incidence of hypotension in patients receiving epidural analgesia ranges from 1.2 to 22%.[3-5,7-9] The odds ratios are 2.78-13.76 compared with systemic analgesia.[2,6]

Liu et al,[9] found that factors associated with hypotension were female, body weight less than 73 kg, and analgesic adjuncts. Curatolo et al,[10] found the probability of hypotension increased when epidural fentanyl was administered, high body weight and widespread of epidural analgesia. In contrast, it decreased when a tourniquet was used, and bupivacaine instead of carbonated lidocaine was administered. Olson et al,[11] found that low systolic and diastolic blood pressures, pre-operative diuretics and total IV fluid administered in the first post-operative day were associated with hypotension.

The purpose of this study was to investigate risk factors for hypotension within 24 hours after operations in patients receiving epidural analgesia.

MATERIALS AND METHODS

The study design was a matched case-control study. After the study protocol was approved by the Institution Review Board, data were collected from acute pain service (APS) medical records at Siriraj hospital retrospectively from September 2006 to February 2012, for 60 case patients and 240 control patients. The inclusion criterion was patient receiving epidural analgesia. We excluded the patients admitted to Intensive Care Unit (ICU) or High Dependency Unit (HDU) after operations and obstetric patients. All patients were managed with standardized post-operative care. Vital signs and pain scores were recorded hourly for 12 hours and then every 2 hours for 12 hours after operations. All patients received the same standardized epidural management. The case was the patient receiving epidural analgesia with 1) blood pressure < 90/50 mmHg or less than 20% from baseline, measured at least twice, within 24 hours after operations or 2) hypotension that required management. The control was the patient receiving epidural analgesia with no event of BP < 90/50 mmHg. Matching factors included 1) age difference within 5 years old, 2) sex, and 3) site of surgery (intrathoracic, upper abdomen, lower abdomen, and extremities).

Primary outcomes were risk factors for hypotension in epidural analgesia, which were categorized as patient, surgical and anesthetic factors. Patient factors included body mass index, body weight, height, pre-operative blood pressure, ASA classification, underlying diseases (diabetes mellitus-DM, hypertension, coronary artery disease-CAD, chronic kidney disease), current medications (diuretics, beta-blockers, alpha-blockers, ACE inhibitors, angiotensin receptor blockers, calcium channel blockers), bowel preparation, intravenous fluid replacement after fasting, and pre- and post-operative anemia. Post-operative hematocrit was recorded within 24 hours after operation. The anemic cut point was hemoglobin less than 10 gm/dL.

Surgical factors comprised of operation in malignancy, operative time, blood loss, blood transfusion, and urine output. Urine output less than 0.5 mL/kg/hr were classified as low urine output reflecting inadequate intravascular volume.

Anesthetic factors included choice of anesthesia, site of epidural catheter and its appropriateness (Table 1), agents administered via epidural route, episodes of intraoperative hypotension and/or after any local anesthetic bolus doses, patient-controlled epidural analgesia use, additional systemic analgesia, and the agents administered.

Statistical analysis

A pilot study was conducted in 10 hypotensive patients (case) and 26 normotensive patients (control). Risk factors that were proposed to contribute to hypotension comprised of bowel preparation, blood loss more than 500 mL, diuretics use, hypertension, DM, and operative time more than 4 hours. The

TABLE 1. Site of epidural catheter placement which is considered appropriate to the site of surgery.

Site of catheter	Operation
High to mid thoracic	Thoracic surgery
(T5 – T8 level)	Upper abdominal surgery (esophagectomy, gastrectomy, open cholecystectomy, pancreatic surgery)
	Abdominal aortic aneurysm surgery
Mid to low thoracic	Lower abdominal surgery (colectomy)
(T8 – T12 level)	Nephrectomy
Low thoracic to high	Lower abdominal surgery
lumbar (T10 – L2 level)	Pelvic surgery (hysterectomy, radical prostatectomy)
Lumbar (L1 – L4)	All lower extremity procedures (knee, vascular bypass)
	Hip surgery

only factor which was significant in the pilot study was operative time. In patients without hypotension, 61% of them had an operative time more than 4 hours, compared with 80% in hypotensive group. A sample size of 60 patients in the case group and 240 patients in the control group were calculated for a 0.05 difference (2-sided) with a power of 80%.

Descriptive statistics were used for demographic data. Categorical data were expressed as numbers and percentage. Normally distributed continuous data were expressed as mean and standard deviation. Median, maximum and minimum values were used for continuous data which were not normally distributed.

Identification of risk factors was calculated by using inferential statistics. Chi-square test or Fisher's exact test was used to analyze the correlation between discrete variables and post-operative hypotension. Continuous data were analyzed using independent t-test or Mann-Whitney U test. The factors with p-value < 0.2 were included in analysis in multiple logistic regression with adjusted odds ratio (OR) and 95% confidence interval. A p-value of < 0.05 was considered significant. The statistical analyses were performed using SPSS version 17.0.

RESULTS

Demographic data showed no differences between the case and the control groups (Table 2). The comparison of patient, surgical and anesthetic risk factors have been shown in the Tables 3, 4, and 5.

The factors with p-value < 0.2 were body weight, systolic blood pressure, diastolic blood pressure, DM, CAD, pre- and post-operative anemia, catheter site, and use of intraoperative bupivacaine. These factors were adjusted using multivariate analysis except alpha-blocker which was not analyzed in the model. Alpha-blocker was excluded because there was no

TABLE 2. Demographic data (matched). Values are mean (SD) or number (proportion).

		Case, n = 60	Control, n = 240
Age (years)		58.2 (11.9)	58.0 (11.4)
Sex	Male	16 (26.7)	64 (26.7)
	Female	44 (73.3)	176 (73.3)
Surgical site	Thoracic	9 (15.0)	36 (15.0)
	Upper abdomen	18 (30.0)	72 (30.0)
	Lower abdomen	27 (45.0)	108 (45.0)
	Extremities	6 (10.0)	24 (10.0)

TABLE 3. Comparison of patient risk factors. Values are mean (SD) or number (proportion).

Patient factors	Case, n = 60	Control, n = 240	p-value
Body mass index (BMI)	23.0 (3.9)	23.7 (4.3)	0.247
Body weight	56.5 (9.5)	59.1 (11.4)	0.098
Height	156.8 (8.7)	157.9 (7.9)	0.339
Preoperative lowest SBP	111.6 (12.4)	116.6 (16.4)	0.030
Preoperative lowest DBP	67.2 (9.9)	69.8 (9.6)	0.060
ASA classification			0.698
ASA 1	13 (21.7)	45 (18.8)	
ASA 2	40 (66.7)	173 (72.1)	
ASA 3	7 (11.6)	22 (9.1)	
Underlying diseases[†]			0.612
Diabetes Mellitus	5 (8.3)	43 (17.9)	
Hypertension	19 (31.7)	89 (37.1)	
Coronary Artery Disease	4 (6.7)	5 (2.1)	
Chronic Kidney Disease	1 (1.7)	4 (1.7)	
Medications			0.828
Diuretics	5 (8.3)	19 (7.9)	
Beta-blockers	11 (18.3)	32 (13.3)	
Alpha-blockers	0 (0)	13 (5.4)	
ACE Inhibitors	2 (3.3)	14 (5.8)	
Angiotensin receptor blockers	6 (10.0)	16 (6.7)	
Calcium channel blockers	8 (13.3)	44 (18.3)	
Bowel preparation	24 (40.0)	83 (34.6)	0.433
Received intravenous fluid since fasting	17 (28.3)	65 (27.1)	0.846
Pre-operative hemoglobin < 10 gm/dL	10 (16.7)	25 (10.4)	0.177
Post-operative hemoglobin < 10 gm/dL	21 (35.0)	28 (11.7)	< 0.001

SBP = systolic blood pressure, DBP = diastolic blood pressure, ACE = angiotensin converting enzyme

[†] Some patients have more than one underlying diseases

TABLE 4. Comparison of surgical risk factors. Values are number (proportion) or median (min-max).

Surgical factors	Case, n = 60	Control, n = 240	p-value
Malignancy case (yes)	43 (71.7)	184 (76.7)	0.419
Operative time (minutes)	170 (55-480)	160 (20-405)	0.503
Operative time > 4 hours (yes)	14 (23.3)	41 (17.1)	0.263
Blood loss (mL)	300 (40-3500)	300 (0-2500)	0.450
Blood loss > 500 mL (yes)	21 (35.0)	71 (29.7)	0.427
Blood transfusion (yes)	10 (16.7)	34 (14.2)	0.624
Low urine output			0.937
Yes	8 (13.6)	38 (16.0)	
No	50 (84.7)	195 (81.9)	
N/A	1 (1.7)	5 (2.1)	

N/A = Not applicable (urine output could not be determined due to bladder surgeries)

TABLE 5. Comparison of anesthetic risk factors. Values are number (proportion) or median (min-max).

Anesthetic factors	Case, n = 60	Control, n = 240	p-value
Choice of anesthesia			0.827
General anesthesia + Epidural block	57 (95)	228 (95)	
Epidural anesthesia	0 (0)	2 (0.8)	
Combined spinal epidural (CSE)	3 (5)	10 (4.2)	
Level of catheter site			0.191
Upper Thoracic < T7	5 (8.3)	39 (16.3)	
Lower Thoracic (T8-12)	28 (46.7)	89 (37.0)	
Lumbar	27 (45.0)	112 (46.7)	
Inappropriate catheter site (yes)	27 (45.0)	104 (43.7)	0.856
Hypotension after bolus dose (yes)	16 (26.7)	58 (24.2)	0.688
Intraoperative hypotension (yes)	34 (56.7)	137 (57.1)	0.954
Intraoperative agents			1.000
Local anesthetics + opioid	58 (96.7)	231 (96.3)	
Local anesthetics only	2 (3.3)	9 (3.8)	
Lidocaine (test dose excluded) (yes)	24 (40.0)	101 (42.1)	0.770
Bupivacaine (yes)	52 (86.7)	188 (78.3)	0.149
Fentanyl (yes)	22 (36.7)	70 (29.2)	0.260
Morphine (yes)	54 (90.0)	222 (92.5)	0.594
Lidocaine			
Average intraoperative amount (mg/hr)	27.45 (0-416)	30.87 (0-685)	0.416
Total amount (mg)	60 (30-100)	50 (30-120)	0.318
Bupivacaine			
Average intraoperative amount (mg/hr)	4.41 (0-25)	4.15 (0-34.62)	0.861
Average post-operative amount (mg/hr)	3.125 (0-4.38)	3.125 (0-6.25)	0.503
Total amount in 24 hrs (mg)	75 (15-105)	75 (22.5-155.63)	0.361
Post-operative systemic analgesia* (yes)	37 (61.7)	127 (52.9)	0.223
Post-operative PCEA (yes)	2 (3.3)	5 (2.1)	0.630

PCEA = patient-controlled epidural analgesia

* Intravenous or oral analgesics

TABLE 6. Multivariate analysis.

	Adjusted Odd's ratio	95% CI for adjusted OR Lower	Upper	p-value
Body weight	0.992	0.962	1.023	0.608
Systolic BP	0.986	0.960	1.013	0.319
Diastolic BP	0.988	0.948	1.029	0.561
Diabetes mellitus	0.370	0.126	1.083	0.070
Coronary artery disease	6.357	1.378	29.326	**0.018**
Pre-operative anemia	0.967	0.388	2.410	0.943
Post-operative anemia	4.132	2.026	8.428	**< 0.001**
Catheter at upper thoracic†	0.514	0.174	1.520	0.229
Catheter at lower thoracic†	1.188	0.623	2.264	0.601
Intraoperative bupivacaine usage	1.725	0.732	4.065	0.212

†Compared with catheter at lumbar level

patient taking this medication in the case group. The results showed that CAD and post-operative anemia were statistically significant risk factors with p-value 0.018 and < 0.001; and OR 6.36 (95% CI 1.38, 29.33) and 4.13 (95% CI 2.03, 8.43), respectively (Table 6).

DISCUSSION

We found only two factors that associated with hypotension within 24 hours after operations in patients receiving epidural analgesia. They were the presence of coronary artery disease (CAD) and post-operative anemia which were not consistent with any reviewed literatures. Thus epidural analgesia should be managed cautiously in these groups of patients to avoid post-operative hypotension. The other factors showed no correlations with hypotension.

Coronary artery disease was significant at odds ratio 6.3, 95% confidence interval (CI) 1.38 - 29.33. The CAD patients might have less cardiac reserve than a normal population. They might not tolerate the hemodynamic changes well even when preload or afterload changes just slightly.

Post-operative anemia was a significant factor at odds ratio 4.13, 95% CI 2.03-8.43. This may be explained by intra- and post-operative blood loss leading to hypovolemic status. Epidural infusion may exaggerate the effects of hypotension in these patients.

The previous studies found many factors related to hypotension, which were different to ours. Body weight less than 73 kg and analgesic adjuncts were significant factors from the study of Liu et al.[9] In our study, mean body weight in both groups were less than 60 kg, and was not a significant factor. Epidural fentanyl and bupivacaine instead of lidocaine usage were significant factors from Curaloto's study.[10] Post-operative bupivacaine concentration cannot be considered as a risk factor of hypotension in this study because nearly all patients received the same concentration at 0.0625%, only three of them received other concentrations. Low SBP, DBP, and diuretics usage were also stated in Olson's study.[11] These factors were not significant in our study.

Limitations

Firstly, as this was a retrospective study, the diagnosis of CAD was dependent on the primary doctors. Our populations were classified as CAD whenever they had a history of ischemic heart disease. Not all of them had been confirmed with coronary angiography. Secondly, our study found that the intraoperative volume status was similar between the groups, but we did not record the volume status after the operations, i.e., bleeding from surgical drainage or intake and output volume. Moreover, patients' post-operative hemoglobin levels in our study were not measured immediately after operation, but usually on the following morning on the ward. Hence some post-operative anemic patients who had events of hypotension might be in hypovolemic state as well since the operation had been finished.

CONCLUSION

Risk factors associated with hypotension within 24 hours after operations in patients receiving epidural analgesia were coronary artery disease and post-operative hemoglobin less than 10 gm/dL. Other surgical or anesthetic factors had no association.

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