Prospective Study of Hypotension and Bradycardia during Spinal Anesthesia with Bupivacaine: Incidence and Risk Factors, Part Two

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Objective: *Hypotension and bradycardia during spinal anesthesia are common and may relate to severe adverse events such as cardiac arrest or death. The authors' first retrospective study identified three non-modifiable factors including females, age more than 40 years, and type of operation. Level of blockage higher than T5 was the only one modifiable factor that could be confirmed. That study was strongly limited by the nature of the retrospective anesthetic record reviewed study.*

Material and Method: *The authors prospectively studied the records of 2,000 patients who received spinal anesthesia at Sriraj Hospital from 1 July 2004 to 31 December 2004. The collected parameters were patient demographic data (sex, age, body weight, height, ASA status), operative data (type of operation, emergency status, position and duration of operation), anesthetic data (type and dosage of local anesthetic agents used, intravenous fluid, vasoactive and sedative agents, highest sensory level of spinal blockage, usage and doses of spinal opioids). Recording forms of hypotension and bradycardia were completed by the responsible anesthetic team in each consecutive patient.*

Results: *Incidence of hypotension (20% or more decrease in systolic blood pressure) in the present study was 57.9%. The highest incidence was in cesarean section. Four non-modifiable risk factors could be identified which included females, age more than 50, body mass index more than 35 (OR = 2.1, 95%CI 1.01-4.29) and type of operation. Two modifiable risk factors included high dose of heavy bupivacaine (OR 1. 88, 95%CI 1. 3-2.74) and level of sensory blockage equal to or higher than T5 (OR 2.27, 95%CI 1.73-2.97).*

Conclusion: *Usage of high dose of heavy bupivacaine and level of blockage higher than T5 were two modifiable risk factors associated with hypotension during spinal anesthesia. Avoidance of high block and lower dose of heavy bupivacaine can reduced the incidence and severity of hypotension after spinal anesthesia.*

Keywords: *Risk factors, Hypotension, Spinal bupivacaine*

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Hypotension and bradycardia are common side effects of spinal anesthesia and can lead to serious complications i.e. cardiac arrest or death. However, the latest review of incidence and potential risk factors for hypotension and bradycardia during spinal anesthesia was reported in 1992 (33% and 13% respectively)[1,2]. The first part of the present study reported the incidence of moderate hypotension of more than fifty percent (54.4%) after spinal anesthesia at Siriraj Hospital[3]. That retrospective anesthetic record reviewed could confirm three non-modifiable risk factors of hypotension were female, age more than 40, and type of operation. Sensory level of equal to or more than fifth thoracic dermatome level (T5) was the only one modifiable risk factor of hypotension. But the reviewed hand writing anesthetic records may easily miss or omit some short hemodynamics changed. There were records of administration of vasopressor without record of hypotension. Part two is the re-evaluation of the incidence and risk factors of hypotension and bradycardia after spinal anesthesia, in a prospective study in patients

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who received successful spinal anesthesia in Siriraj Hospital from 1 July 2004 to 31 December 2004.

Material and Method

The authors' prospective study of hemodynamic shows changes in 2000 patients who received spinal anesthesia and underwent surgery in four surgical units (orthopedics, urology, general and obstetrics and gynecology surgery). All patients signed consent for surgery and anesthesia. Recording forms of hypotension and bradycardia were completed by the responsible anesthetic team at the end of the operation for each consecutive patient.

The authors selected only cases when spinal anesthesia could be used as a sole anesthetic technique. Combinations of spinal block with other type of anesthesia (epidural block, inhalation or intravenous sedation, and general anesthesia) were excluded. The authors also excluded cases when the supplementation of high dose opioids (morphine more than 0.1 mg/kg, pethidine more than 1 mg/kg, fentanyl more than 1 microgram/ kg), sedative agents (midazolam more than 2 mg, ketamine more than 1 mg/kg, or propofol more than 1.5 mg/kg) were used within 60 minutes after spinal block.

The detailed parameter of surgery (type of operation, surgical position, duration and emergency situation), patient demographic data (sex, age, body weight, height, ASA physical status), and anesthetic data (type and amount of local anesthetic agents, presence and doses of spinal opioids, the highest level of sensory blockage, intravenous fluid, vasoactive and sedative agents) were recorded. The standard practices of oxygen supplementation and digital monitoring of oxygen saturation and EKG were performed. Automatic noninvasive blood pressure was used routinely and recorded every minute for fifteen minutes after spinal block.

The first systolic, diastolic blood pressure, and heart rate recorded in the operating room were used as reference control values. The lowest systolic, diastolic pressure, heart rate and onset of those incidences were recorded in detail. Treatment of hypotension and bradycadia depended on individual clinical judgments of responsible anesthesiologists. All vasoactive agents used were recorded. Anesthetic and hypotension record of each patient were kept together and used both in reviewing the lowest blood pressure and heart rate and first onset of that event.

All parameters were coded and recorded in SPSS 10.0. Bradycardia was counted only when the heart rate was equal to or lower than 50 beats per minute in the patient who had a controlled heart rate of more than 50 beats per minute.

Statistical analysis

Descriptive statistics were presented as mean, standard deviation (SD), minimum, maximum, or number (%) as appropriate. All parametric and non-parametric parameters were test of normal distribution before further appropriated statistically analysis. P-value of 0.05 was used to identify statistical significance. To assess the association between two categorical variables in a univariable analysis, chi-square test was used along with crude odds ratio (OR) and its 95% confidence interval (CI). Multivariable analysis via multiple logistic regressions was employed to determine the effect of each independent variable on binary dependent variable after adjusting for the other independent variables. Results were displayed as crude and adjusted OR together with 95%CI for OR.

Results

Demographic data

Two thousand patients aged between 14 and 99 years were eligible for the present study. They were patients in the division of Orthopedics 32.1%, Obstetrics 40.4%, Urology 15.8%, and general surgery 11.7%. The percentage of male and female was 33.1 and 66.9 respectively. They were classified in ASA class 1 and 2 for 94.3%, BMI lower than 35 for 70%, and were operated under emergency situation for 20.5% (Table 1).

Hyperbaric bupivacaine was used as spinal local anesthetic agent in 94.4% in the present study. So in the analysis relating to the use of local anesthetic agents, such as the amount of spinal drug, cases of isobaric bupivacaine were excluded.

The authors divided the dose range of 0.5% heavy bupivacaine into three groups by 25 and 75 percentile of number of patients in each operation. "Low dose", "Average dose" and "High dose" represented equal or lower than 25 percentile, more than 25 percentile to lower than 75 percentile and 75 percentile or more respectively (Table 2). The dose ranges varied according to the type of operation and physiology change. The dose variation was least in cesarean section (Mean, Mode, 25%, 50%, and 75% were in between 2-2.3 ml and very narrow SD).

Incidence of hypotension

The incidence of hypotension varied by defi-

nition of hypotension and cut point. The incidence was 57.9% when hypotension was defined as reduction of systolic blood pressure to 20% or more of the controlled systolic pressure (Table 3). This incidence reduced to 47.9% when two criteria were used (reduction to 20% of control value and systolic pressure was lower than 100 mmHg). The incidence was highest in cesarean section by means of any definition. The inci-

Table 1. Demographics data of 2000 cases of spinal anesthesia

Parameter	Number (%)	Range	Mean ± SD
Gender			
Male	662 (33.1)		
Female	1338 (66.9)		
Age (yr)		14-99	44.02 ± 19.17
Body weight(kg)		32-120	64.06 ± 12.02
Height (cm)		140-198	159.58 ± 7.34
BMI (kg/m^2)		13.01-48.07	25.10 ± 4.5
ASA classification			
1	836 (41.8)		
2	1051 (52.6)		
3	113 (5.7)		
Emergency	409 (20.5)		
Spinal bupivacaine			
Hyperbaric	1887 (94.4)		
Isobaric	113 (5.6)		
Add morphine	1064 (53.2)		

Table 2. Dose in milliliter of 0.5% heavy bupivacaine*

Heavy Bupivacaine	Number	Range	Mean	mode	SD	25%	50%	75%
Peri-anal	103	1.5-3.2	2.28	2.5	0.53	2	2.2	2.6
TUR	298	1.4-3.5	2.46	2.5	0.49	2.1	2.5	2.8
Knee	450	1.7-3.5	2.65	3	0.4	2.5	2.7	3
Femur	105	2-3.5	2.85	3	0.39	2.6	2.8	3
Lower abdomen	108	1.8-3.6	2.65	2.5	0.48	2.4	2.6	3
C/S	795	1.2-2.7	2.16	2.2	0.2	2	2.2	2.3

* Dose varies significantly between group of operation ($p < 0.005$)

Table 3. Variation of incidence of hypotension to definition of hypotension and group of operation (% of cases in each group)

Operation	Total cases	≥ 20% ofcontrol	< 100 mmHg	< 90 mmHg	≥ 20% of control and < 100 mmHg
Total cases	2000	57.9	57.1	41.1	47.9
Peri-anal	124	35.5	47.0	21.8	26.6
TUR,TUI*	317	49.8	35.0	21.5	32.2
Knee and leg*	485	46.4	44.1	28.5	34.8
Hip and femur*	157	52.2	51.6	40.8	45.2
Lower abdomen*	110	54.5	58.2	41.8	48.2
C/S*	807	72.9	77.4	59.2	65.1

***** Incidence of hypotension were higher in every group of operation compared to "peri-anal" ($p<0.005$)

Table 4. Univariated analysis of the risk factor of hypotension (reduction of systolic blood pressure more than or equal to 20% of controlled pressure)

Variable	Hypotension, n (%)		Crude OR	95%CI for OR	p-value
	No	Yes			
Gender					
Male	459 (69.3)	203 (30.7)			
Female	591 (44.2)	747 (55.8)	2.86	2.35, 3.48	0.000
Age group (year)					
< 20	66 (61.1)	42 (38.9)	1		
20-29	219 (47.9)	238 (52.1)	1.71	1.13, 2.62	0.000
30-39	230 (44.3)	289 (55.7)	1.98	1.29, 3.02	
40-49	100 (54.6)	83 (45.4)	1.30	0.80, 2.12	
50-59	108 (52.2)	99 (47.8)	1.44	0.90, 2.31	
60-74	230 (64.2)	128 (35.8)	0.88	0.56, 1.36	
> 74	97 (57.5)	71 (42.3)	1.15	0.70, 1.88	
Body mass index (kg/m^2)					
< 25	628 (60.1)	417 (39.9)	1		
25-35	408 (45.5)	488 (54.5)	1.80	1.50, 2.16	0.000
> 35	14 (24.6)	43 (75.4)	4.63	2.50, 8.56	0.000
ASA					
Class 1	448 (53.6)	388 (46.4)	1		
Class 2	531 (50.5)	520 (49.5)	1.13	0.94, 1.36	0.046
Class 3-4	69 (62.2)	42 (37.8)	0.70	0.47, 1.06	
Emergency :yes	169 (41.3)	240 (58.7)	1.76	1.41, 2.2	0.000
Operation					
Peri-anal	91 (73.4)	33 (26.6)	1		
TUR/TUI	218 (68.8)	99 (31.2)	1.3	0.70, 2.40	
Knee/leg	316 (65.2)	169 (34.8)	1.48	0.95, 2.29	
Hip/femur	86 (54.8)	71 (45.2)	2.28	1.37, 3.78	0.000
Lower abdomen	57 (51.8)	53 (48.2)	2.56	1.49, 4.43	0.000
C/S	282 (34.9)	525 (65.1)	5.13	3.36, 7.84	0.000
Systolic lower than 120 mmHg	417 (49.1)	432 (50.9)	1.27	1.06, 1.50	0.009
Dose spinal bupivacaine					
Low dose	215 (69.6)	94 (30.4)	1		
Average	541 (48.8)	567 (51.2)	2.40	1.83, 3.14	0.000
High dose	293 (50.4)	288 (49.6)	2.25	1.68, 3.01	0.000
Add morphine: yes*	429 (40.3)	635 (59.7)	2.92	2.43, 3.50	0.000
Sensory Level T_5* or higher	462 (44.4)	578 (55.6)	1.98	1.65, 2.36	0.000
Total volume (ml)					
< 500	185 (81.9)	41 (18.1)	1		
501-1000	341 (62)	209 (38)	2.77	1.89, 4.04	0.000
1001-1500	311 (46.7)	355 (53.3)	5.15	3.55, 7.46	
>1500 ml	213 (38.2)	345 (61.8)	7.31	5.00, 10.68	

Crude OR = crude odds ratio

dence of hypotension was lowest in perianal operations. The authors used perianal operation as reference in further analysis.

Comparing between patients with and without hypotension, when each variable was considered alone as in univariable analysis seven non-modifiable and three modifiable risk factors were identified. Sex of female, increasing age, body mass index more than 35, ASA classification from I to II, controlled systolic blood pressure lower than 120 mmHg, type of operation, and emergency surgery were seven non-modifiable risk factors that increased the incidence of hy-

Table 5. Univariated analysis of the risk factor of bradycardia (Equal to or less than 50 beats/min)

Variable		Bradycardia, n (%)		Crude OR (95%CI)	p-value
		No	Yes		
Gender	Female	1166 (87.1)	172 (12.9)	1	0.000
	Male	507 (76.6)	155 (23.4)	2.07 (1.63, 2.64)	
Age (yr)	< 20	96 (88.9)	12 (11.1)	1	
	20-29	402 (88.0)	55 (12.0)	1.10 (0.56, 2.12)	0.000
	30-39	461 (88.8)	58 (11.2)	1.00 (0.52, 1.95)	
	40-49	159 (86.9)	24 (13.1)	1.21 (0.58, 2.53)	
	50-59	159 (76.8)	48 (23.2)	2.42 (1.22, 4.77)	
	60-74	275 (76.8)	83 (23.2)	2.42 (1.26, 4.62)	
	> 74	121 (72.0)	47 (28.0)	3.11 (1.56, 6.18)	
Body mass index(kg/m^2)	< 25	852 (81.5)	193 (18.5)	1	0.002
	25-35	765 (85.4)	131 (14.6)	0.76 (0.59, 0.96)	
	> 35	55 (96.5)	2 (3.5)	0.16 (0.04, 0.66)	
ASA	Class 1	708 (84.7)	128 (15.3)		0.651
	Class 2	870 (82.8)	181 (17.2)		
	Class 3-4	93 (83.8)	18 (16.2)		
Emergency	Yes	387 (94.6)	22 (5.4)		0.000
Operation	Peri-anal	107 (86.3)	17 (13.7)	1	0.000
	TUR/TUI	238 (75.1)	79 (24.9)	2.09 (1.18, 3.70)	
	Knee/leg	365 (75.3)	120 (24.7)	2.07 (1.19, 3.59)	
	Hip/femur	126 (80.3)	31 (19.7)	1.55 (0.81, 2.95)	
	Lower abdomen	82 (74.5)	28 (25.5)	2.15 (1.10, 4.19)	
	C/S	1673 (83.7)	327 (16.3)	1.23 (0.73, 2.08)	
Systolic lower than 120 mmHg		730 (86.0)	119 (14.0)	0.74 (0.58, 0.94)	0.015
Dose spinal	Low dose	265 (85.8)	44 (14.2)	1	
	Average	941 (84.9)	167 (15.1)	1.07 (0.75, 1.53)	0.025
	High dose	466 (80.2)	115 (19.8)	1.49 (1.02, 2.17)	
Morphine*	No	765 (80.4)	193 (19.6)	1	0.000
	Yes	920 (86.5)	144 (13.5)	0.62 (0.49, 0.79)	
Sensory level ≥ T5		892 (85.8)	148 (14.2)	0.72 (0.57, 0.92)	0.008
Total volume (ml)	< 500	195 (86.3)	31 (13.7)	1	
	501-1000	468 (85.1)	82 (14.9)	1.10 (0.71, 1.72)	0.03
	1001-1500	565 (84.8)	101 (15.2)	1.12 (0.73, 1.74)	
	> 1500	445 (79.7)	113 (20.3)	1.15 (1.04, 2.46)	

potension in the varying range of crude odds ratio from 1.30 to 5.13 with narrow 95%CI for OR (Table 4). Level of sensory analgesia equal to or higher than T5, increasing dose of heavy bupivacaine and adding of morphine were only three modifiable risk factors that increased the incidence of hypotension with relatively high crude odds ratio and narrow 95%CI for OR (Table 4).

Total volume of fluid replacement was significantly higher in the hypotensive group with the trend increase of odds ratio from lower than 500 ml to more than 1500 ml (Table 4). The increased total volume replacements were the results of the treatment of hypotension by fluid loading. The more severe hypotension, the more fluid was used to compensate venous pooling after block and to maintain adequate venous return and blood pressure.

Not all positive parameters were included in further analysis of regression models. Sex and "add morphine" were omitted from regression model because the distribution of sex was not equal in every group of operation. Even "add morphine" had an odds ratio of 2.92 (95%CI 2.43-3.50), but 80% of these patients were caesarean section. Taking into account all factors simultaneously in multiple logistic regression analysis, increasing age, body mass index of more than 35, and

dose of heavy bupivacaine had step by step increases in adjusted, odd ratios (Table 6) with p-value of < 0.001 when the age was more than 50, p-value of 0.05 when BMI of more than 35, and p-value of < 0.01 when average and high doses of heavy bupivacaine were used compared to low doses. Type of operation of cesarean section, lower abdomen and operation of hip or femur were the operations that increased the risk of hypotension after spinal block. Sensory level equal to or higher than T5 was significant (p < 0.001) increased OR (2.27 with 95%CI 1.73-2.97). The influence of "Controlled systolic blood pressure equal to or lower than 120 mmHg" was overcome by other factors in logistic model and not the risk of hypotension (p-value of 0.65 and 95%CI 0.83-1.35) (Table 6).

Incidence of bradycardia

Three hundred and twenty-seven patients (16.4%) had a heart rate that decreased to lower than or equal to 50 beats/min. Even p-value from univariated analysis of all studied factors was less than 0.05. Only crude odd ratios of sex of male, age equal to or more than 50 year and high dose of heavy bupivacaine were identified as risk factors of bradycardia after spinal block (Table 5). No further statistic analysis was done.

Usage of vasoactive agents

Ephedrine was the most common vasoactive agent used in the treatment of hypotension after spinal block. At least one dose of ephedrine or Levophed was given in 44.7 and 30. 8% of all patients, respectively. The number of patients and dosage of vasoactive agents (ephedrine and Levophed) were significantly higher in "hypotensive" patients (Table 7). However, 40, 6 and 7, 6% of "non-hypotensive" patients received ephedrine and Levophed respectively. This confirmed that in real situations the decision to use a vasoactive agent could be made before the systolic blood pressure decreased to meet the studied criteria.

Onset of peak hypotension and bradycardia

The peak onset of hypotension and bradycardia was as early as one and three minutes after spinal block respectively. In some cases, the lowest blood pressure occurred at 45 minutes after block and might be the effect of other reasons such as blood loss. But 50% and 75% of all cases, the lowest blood pressures and heart rate were recorded at 3. 5 and 5 minutes respectively (Table 8). Onset of bradycardia was longer than hypotension by means of every calculation of mean value, SD and 25, 50, and 75 percentile.

Table 6. Logistic Regression and variables associated with hypotension

Variable		Adjusted OR	95%CI for OR		p-value
			Upper	Lower	
Age (year	20-29	0.97	0.56	1.68	0.92
	30-39	1.11	0.64	1.92	0.71
	40-49	1.80	0.95	3.41	0.07
	50-59	3.48	1.84	6.58	0.00
	60-74	2.58	1.36	4.83	0.00
	> 74	3.47	1.69	7.12	0.00
BMI (kg/m^2)	25-35	1.14	0.90	1.45	0.29
	> 35	2.08	1.01	4.29	0.05
ASA	class 2	1.03	0.47	1.33	0.85
	≥ class 3	1.10	0.62	1.95	0.73
Emergency		1.05	0.77	1.43	0.74
Systolic pressure ≤ 120 mmHg		1.06	0.83	1.35	0.65
Operation					
	TUR/TUI	0.77	0.41	1.46	0.43
	Knee/leg	1.08	0.60	1.96	0.80
	Hip/femur	1.98	1.00	3.95	0.05
	Lower abdomen	1.58	0.77	3.23	0.21
	Cesarean Section	4.32	2.26	8.25	0.00
Dose	Average dose	1.71	1.21	2.4	0.00
	High dose	1.89	1.30	2.74	0.00
Sensory level ≥ T5		2.27	1.73	2.97	0.00

Table 7. Usage of vasoactive agents

Vasoactive drug	Total cases (n = 2000)	Hypotension group (n = 1157)	Non-hypotension group (n = 843)	p-value
Ephedrine(mg)				
Yes	894 (44.7%)	771 (66.4%)	123 (14.6%)	<0.001
Range	3-60	3-60	3-45	
Mean/SD	16.6 ± 9.5	17.2 ± 9.7	13.1 ± 7.38	
≤ 10 mg	207 (23.2%)	164 (21.3%)	43 (34.9%)	
10-19 mg	443 (49.6%)	375 (48.6%)	68 (55.3%)	
≥ 20 mg	244 (27.3%)	232 (30.1%)	12 (9.8%)	
Levophed (microgm)				
Yes	616 (30.8%)	552 (47.7%)	64 (7.6%)	<0.001
Range	2-72	2-72	2-32	
Mean/SD	11 ± 9.28	11.29 ± 9.54	8.25 ± 6.10	
≤ 8 microgm	397 (64.5%)	346 (62.7%)	51 (79.7%)	
> 8-20 microgm	156 (25.3%)	146 (26.5%)	10 (15.6%)	
> 20 microgm	63 (10.2%)	60 (10.9%)	3 (4.7%)	
Atropine (mg)				
Yes	157 (7.9%)	113 (9.8%)	44 (5.2%)	<0.001
Range	0.3-1.2	0.3-1.2	0.3-1.2	

Table 8. Peak onset of hypotension and bradycardia (minute)

Onset (min)	Minimum	Maximum	Mean/SD	Percentile			
				10	25	50	75
Systolic hypotension	1	45	4.7 ± 4.9	1	2	3.5	5
Diastolic hypotension	1	55	5.9 ± 9.8	4	5	15	20
Bradycardia	3	60	15 ± 15	7	9	16	35

Discussion

Incidence of hypotension during spinal anesthesia in the present study was 57.9% compared with the study of Carpenter et al, 33%, Tarkkila and Isola, 15.3% and Hartmann et al, 8.2%[1,2,4]. The studies' criteria of hypotension were the main factors of these variations. When the authors used the criteria of systolic blood pressure lower than 90 mmHg, which was the same criteria of Carpenter[2], the presented incidence was then reduced from 57.9% to 41.1% (Table 3) and was close to the result in Carpenter's study. Other factors which made it different included type and ratio of each operation, study designs, instituting practice guidelines, dose variation, and data collection processes. Changing from pure retrospective anesthetic record reviewed[3] to prospective data collection, the incidence of hypotension and bradycardia increased from 54.4 and 6.5% to 57.9 and 16.4% respectively. These confirmed the authors' hypothesis that the incidence of hypotension and bradycardia after spinal anesthesia were higher than in other previous studies[1,2,4]. Extended area of sympathetic blockage caused rapid progressive reduction of blood pressure and heart rate. Vasoactive substances were given very early and some time before the blood pressure reduced to the study's criteria. Hypotension commonly (75%) occurred within 5 minutes after block. Effective and frequently monitored blood pressure at least every minute for ten minutes after block was a reasonable suggestion. Efficient management of the physiological effect caused by sympathetic blockage with volume load and early administration of appropriated vasoactive substances could prevent further reduction and restored blood pressure. There was no report of "cardiac arrest related to spinal anesthesia" in both parts of the present study. The institute's awareness, alert, and uniform practice

guidelines, which included fluid load[5-7], oxygen supplement, monitor EKG, recording blood pressure every minute for ten minutes after block, and competent personal were credited for preventing serious outcomes, directly contributed to spinal anesthesia.

Two patients developed cardiac arrest in the first study period. Both of them were confirmed cases of embolic process of thrombus and necrotic tissue. The details of both cases were explained in the first part. Both of them were excluded from all data analysis. The total number of spinal block during the study period in the institute was 4, 674. The incidence of cardiac arrest was 2 from 4,674 cases or 4.3:10,000 and was higher than others that varied from 1.8 to 2.9:10,000[8-12].

"Female" and "add morphine" were two risk factors proved from univariated statistical analysis of high odd ratios with narrow 95% CI and were not included in logistic model because of limitation of statistic model. However, both of them were confirmed risk factors of hypotension after spinal anesthesia.

There were three factors that increased risk of hypotension in stepwise logistic model which included age, BMI and dose of heavy bupivacaine. Age equal to or more than 50 years, BMI > 35 and high dose of heavy bupivacaine were all increased risk of hypotension significantly with adjusted odd ratios 1.71-3.48 and narrow 95% CI. These were differences from the first part of the present study that only age was the only factor that proved to increase risk as step by step. This could be the result of prospective design and more complete data collection such as weight and height. Increased BMI caused the increase of intra-abdominal pressure and promoted relative high sensory blockage after spinal block[13,14].

Both parts of the study confirmed that cesarean section and level of sensory analgesia more than T5 were two other risk factors of hypotension after spinal anesthesia. Two modifiable risk factors could be identified from the second study by adding morphine and increasing the dose of heavy bupivacaine. All of these three modifiable factors should be carefully and technically controlled during spinal block especially in high-risk patients with obesity, old age, and cesarean section.

The incidence of bradycardia in the present study (16.4%) was higher than in the authors' first part (6.5%), but the authors could not correlate with the occurrences of hypotension and could not perform logistic analysis. There should be further investigation in some special groups of patients with low controlled heart rate or patients who have been receiving beta blockers.

The present study confirmed the authors' basic knowledge of the extended area of sensory analgesia after spinal block closely related to increased dose (both volume and milligram) of local anesthetic agent. Both high dose of drugs and sensory analgesia equal to or higher than T5 were risk factors of hypotension after spinal block. Increased intra-abdominal pressure both from increased BMI in obesity patients and full term pregnancy increased the risk of hypotension. The most unexpected risk factor was "add morphine" that increased the risk of hypotension and was not due to increasing the injected volume. The present study could not explain the reason why only a small dose of morphine had this effect, which could be from its potential, central neural, blocking effect of local anesthetic agents.

The incidence of hypotension after spinal anesthesia was high even when practice guidelines were completely followed. This surrogate outcome could be managed with careful monitoring of physiological changes during the sympathetic blockage. Alert and effective personnel are needed for early detection of the beginning of the reduction of both systolic and diastolic blood pressure. Early administration of the appropriate vasoactive agent could prevent further reduction of blood pressure and shorten the duration of the hypotensive period. Ignoring prevention and delayed management of bradycardia and hypotension may lead to a risk of cardiac arrest.

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อุบัติการณ์ภาวะความดันโลหิตต่ำและหัวใจเต้นช้าที่เกิดจากการฉีดยาชาเฉพาะที่เข้าช่องไขสันหลังระยะที่ 2

ฐิติมา ชินะโชติ, ธารา ตริตระการ

วัตถุประสงค์: *ภาวะความดันโลหิตต่ำและอัตราการเต้นของหัวใจช้าพบได้บ่อยในการทำ spinal block โดยที่ภาวะนี้อาจนำไปสู่ภาวะแทรกซ้อนที่รุนแรง เช่นการเกิดภาวะหัวใจหยุดเต้นและการเสียชีวิตของผู้ป่วย การศึกษาระยะที่หนึ่งแสดงความสัมพันธ์ของ เพศหญิง อายุมากกว่า 40 ปี การผ่าตัดและระดับการชาที่เท่ากับหรือสูงกว่า T5 กับการเพิ่มโอกาสการเกิดภาวะความดันโลหิตต่ำจากการฉีดยาชาเฉพาะที่เข้าช่องไขสันหลัง*

วัสดุและวิธีการ: *ทำการศึกษาในผู้ป่วย จำนวน 2000 รายที่ได้รับทำ spinal block ในโรงพยาบาลศิริราช ตั้งแต่วันที่ 1 กรกฎาคม ถึง 31 ธันวาคม พ.ศ. 2547 โดยบันทึกแบบสอบถามการเกิดภาวะความดันโลหิตต่ำ และหัวใจเต้นช้าจากนั้นทำการประเมินความสัมพันธ์ของการเกิดภาวะความดันโลหิตต่ำกับข้อมูลในด้านต่าง ๆ เพื่อค้นหาความสัมพันธ์การ เกิดภาวะความดันโลหิตต่ำ และหัวใจเต้นช้ากับข้อมูลคุณลักษณะผู้ป่วย ชนิดการผ่าตัด รายละเอียดการผ่าตัด ชนิดและปริมาณของยาชาเฉพาะที่ ปริมาณการให้สารน้ำ ชนิดและปริมาณการให้ยาเพื่อเพิ่มความดันโลหิต ระดับการชา และการผสม morphine ร่วมกับการทำ spinal block*

ผลการศึกษา: *อุบัติการณ์ของการเกิดภาวะความดันโลหิตต่ำ(ความดันซิสโตลิค ลดลง 20% หรือมากกว่า) พบได้ 57.9% โดยอุบัติการณ์มากที่สุดในการผ่าตัดเพื่อการคลอดบุตร วิเคราะห์ปัจจัยที่เพิ่มภาวะเสี่ยงของการเกิดภาวะความดันโลหิตต่ำ ได้แก่ ผู้ป่วยที่เป็นเพศหญิง, อายุมากกว่า 50 ปี, ค่าดัชนีมวลกายมากกว่า 35, ปริมาณยาชาเฉพาะที่, ระดับการชาที่เท่ากับหรือสูงกว่า T5 และ การผ่าตัดคลอด*

สรุป: *การใช้ยาชาเฉพาะที่ปริมาณมาก และระดับการชาที่เท่ากับหรือสูงกว่า T5 เป็นปัจจัยที่สามารถควบคุมได้เพื่อลดอุบัติการณ์และความรุนแรงของการเกิดภาวะความดันโลหิตต่ำและอัตราการเต้นของหัวใจช้าในระหว่างการทำ spinal block*