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Factors influencing Bromage score in post-spinal anesthesia patients

Resiana Karnina[1*], Nandya Satyaning Rahayu[2], Muhammad Faruk[3]

[1]Department of Anesthesiology, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia;
[2]Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia;
[3]Department of Surgery, Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia;

*Corresponding author:
Resiana Karnina;
Department of Anesthesiology, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia;
sublime_dr@yahoo.com

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ABSTRACT

Introduction: Bromage score is used in assessing patients post-spinal anesthesia while the patient is in the recovery room. Patients can be transferred to the treatment room from the recovery room if they have achieved a Bromage score of <2. Post-anesthesia recovery is significant to pay attention to because if there are obstacles in post-anesthesia recovery, it will cause some complications that the patient needs a long time in the treatment room. Several factors may be related to Bromage score, American Society of Anesthesiology (ASA) physical status, age, gender, the dose of local anesthetic drugs, and other factors.
Methods: This type of research Observational Analytics used secondary data with a cross-sectional study design with 327 participants. Data analysis using coefficient contingency correlation test.
Results: The majority of 315 (96.6%) patients achieved a Bromage score of 1, with the highest number of patients aged (12-45 years). Patients with ASA physical status 1, a male and spinal anesthetic with a dose of Bupivacaine 10 mg – 15.5 mg achieved the most Bromage score 1. There was a significant relationship between gender and Bromage score in patients after spinal anesthesia, p-value = 0.048 (p-value < 0.05).
Conclusion: There is a significant relationship between sex and the Bromage score, and there is no significant relationship between ASA physical status, age, and local anesthetic dose with the Bromage score.

Keywords: *age, ASA score, bupivacaine, Bromage score, cross-sectional study, spinal anesthesia.*
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INTRODUCTION

In 2015, in the United States, those who underwent outpatient surgery made up 70% of surgical procedures, and in France, it reached 52%.[1] Spinal anesthesia (SA) has been used in more than 4,645 patients in the last 11 years. In another study, laparoscopic cholecystectomy had 3,492 patients with SA elective techniques.[2] SA is the most commonly preferred anesthetic technique and is widely used in operations such as lower extremity surgery, anorectal intervention, urology, obstetrics, gynecology, and lower abdominal procedures.[3]

Post-anesthesia recovery is, of course, also significant to pay attention to.[4] One can use a Bromage score assessment to assess whether the patient can be transferred to the treatment room. The patient may be transferred to the room if the Bromage score is < 2.[5]

Bromage score was introduced in 1965 and is still used today to assess motor blockade in spinal anesthesia patients. At the time when local anesthetic drugs are injected in spinal anesthesia, an assessment of the sensory block and motor block is carried out. After surgery, the patient is transferred to the recovery room and assessed motor blocks with a Bromage score at intervals of 15 minutes.[6] In previous studies, several factors could affect the Bromage score, such as the American Society of Anesthesiology (ASA) score, age, sex, and bupivacaine dose.[5,7-9]

Based on the aforementioned picture, the researchers studied the relationship between Bromage score and influencing factors in post-spinal anesthesia patients in our institution.

METHODS

This analytical observational study used a cross-sectional method. We collected data from all surgical patients under spinal anesthesia admitted to Tangerang Selatan general hospital, Tangerang Selatan, Banten, Indonesia, from January 2020 to December 2020. A total sampling technique was used to collect participants for the study. The participants of this study were all post-spinal anesthesia patients in our institution who met the inclusion criteria. The research instrument used in this study was medical record data. The presentation of the data in this study is in the form of a bivariate table.

Inclusion criteria were all surgical patients under spinal anesthesia, aged >12 years, ASA I to ASA VI, and local anesthesia with pure or adjuvant bupivacaine. Exclusion criteria were patients with incomplete medical record data.

Bromage Score

The Bromage scale is the accepted tool for motor block examination.[10-12] This scale assesses the intensity of the motor block by the patient's ability to move their lower extremities. The classification of these scores, such as scores 1 (**complete block**: unable to move feet or knees), 2

(**almost complete**: able to move feet only), 3 (**partial**: just able to flex knees; free movement of feet), and 4 (**no block**: full movement of knees and feet).

ASA Physical Status

To assess and communicate patient pre-anesthesia medical comorbidities and predict perioperative risk. The ASA score was classified into 5 according to the guidelines of the American Society of Anesthesiologists.[13]

Age

The age of our study participants was classified as 12-45 years old and >45 years old.

Local anesthetic dose

The dose of local anesthetic drug (Bupivacaine) used for spinal anesthesia in surgical patients with adjuvant / without adjuvant. Bupivacaine is the most commonly used local anesthetic for spinal anesthesia.[14] The dosage of bupivacaine was classified into 4 groups, namely (A) Bupivacaine 10 mg – 15.5 mg, (B) Bupivacaine 17.5 – 27.5 mg, (C) Bupivacaine 10 mg – 15.5 mg + Adjuvant, and D) Bupivacaine 17.5 – 27.5 mg + Adjuvant.

Data analysis

We conducted the bivariate analysis using the correlation coefficient contingency test to determine the relationship between the Bromage score and the influencing factors in patients after spinal anesthesia. Data processing using SPSS software version 25.0 (IBM Corp.).

RESULTS

Based on secondary data, the participants in the study were 327 participants that met the inclusion criteria. And as many as 316 people out of 327 (96.6%) have achieved a Bromage score of 1. The relationship between age and Bromage score analysis showed 238 of 247 (96.4%) patients with an age range of 12-45 years with a Bromage score of 1. While patients are elderly (> 45 years), there are 78 out of 80 (97.5%) with a Bromage score of 1. The results of statistical tests obtained p-value = 0.272 where p-value > 0.05, it can be concluded that there is no difference in the proportion of age incidence with Bromage score (no significant relationship between age and Bromage score in patients after spinal anesthesia) (Table 1).

Table 1. The relationship between age with Bromage score.

Age (years)	Bromage Score						p-value
	Score 1		Score 2		Score 3		
	n	%	n	%	n	%	
12-45	238	96.4	3	1.2	6	2.4	0.272
>45	78	97.5	2	2.5	0	0	

Table 2. ASA's relationship with Bromage score.

ASA Physical Status	Bromage Score						p-value
	Score 1		Score 2		Score 3		
	n	%	n	%	n	%	
ASA 1	5	83.3	0	0	1	16.7	0.09
ASA 2	295	96.7	5	1.6	5	1.6	
ASA 3	16	100	0	0	0	0	
ASA 4	0	0	0	0	0	0	
ASA 5	0	0	0	0	0	0	
ASA 6	0	0	0	0	0	0	

**ASA, American Society of Anesthesiology.*

Table 3. Sex relationship with Bromage *score*.

Sex	Bromage Score						p-value
	Score 1		Score 2		Score 3		
	n	%	n	%	n	%	
Woman	249	96.9	2	0.8	6	2.3	0.048
Man	67	95.7	3	4.3	0	0	

Table 4. The relationship of the dose of local anesthetic drugs with Bromage *score*.

Doses of local anesthetic drugs (Group)	Bromage Score						p-value
	Score 1		Score 2		Score 3		
	n	%	n	%	n	%	
A	182	97.3	2	1.1	3	1.6	0.984
B	3	100	0	0	0	0	
C	129	95.6	3	2.2	3	2.2	
D	2	100	0	0	0	0	

The analysis of the relationship between ASA physical status and Bromage scores showed that there were 5 out of 6 (83.3%) physical status of ASA 1 patients with Bromage scores 1. The physical status of ASA 2 patients was 295 of 305 (96.7%) with Bromage scores. 1. The physical status of ASA 3 patients was 16 out of 16 (100.0%), with a Bromage score of 1. The statistical test results obtained p = 0.09 where the p-value > 0.05, it can be said that there is no difference in the proportion of the incidence of ASA physical status with Bromage score (no significant relationship between ASA physical status and Bromage score in post-spinal anesthesia patients) (Table 2).

The analysis of the relationship between sex and Bromage score showed that there were 249 of 257 (96.9%) female post-spinal anesthesia patients with a Bromage score of 1 after the patient was observed for 30 minutes in the recovery room. Meanwhile, there were 67 male patients out of 70 (95.7%) with a Bromage score of 1. The statistical test results obtained p-value = 0.048 where p-value < 0.05, it can be concluded that there is a difference in the proportion of events between women and men (there is a significant relationship between gender and Bromage score in patients after spinal anesthesia), and the contingency coefficient is 0.135, which means that the strength of the relationship

is very weak (Table 3).

The analysis of the relationship between local anesthetic dose and Bromage score showed that 182 out of 187 (97.3%) patients after spinal anesthesia were given pure bupivacaine in a dose range of 10 mg–15.5 mg with a Bromage score of 1. While patients who were given pure bupivacaine ranged from doses of 17.5 – 27.5 mg were 3 out of 3 (100.0%) with a Bromage score of 1. In post-spinal anesthesia patients who were given bupivacaine at a dose of 10 mg – 15.5 mg + adjuvant, there were 129 of 135 (95.6%) with Bromage score 1, and patients who were given bupivacaine at a dose of 17.5 mg – 27.5 mg + adjuvant were 2 out of 2 (100.0%) with Bromage score 1. The results of statistical tests obtained p-value = 0.984 where p-value > 0.05 then it can be concluded that there is no difference in the proportion of the incidence of local anesthetic dose with Bromage score (there is no significant relationship between local anesthetic dose and Bromage score in patients after spinal anesthesia) (Table 4).

DISCUSSION

From the data obtained based on the analysis results, we can conclude that the aged 12-45 years are more likely to undergo spinal anesthesia procedures than the age of the elderly. This is in line with research by Fitria et al. there were 15 out of 17 (88.2%) adults (18-45 years) with a Bromage score of <4 hours. While among the elderly, there are 9 out of 23 (39.1%) reach the Bromage score < 4 hours.[5]

The results of statistical tests showed that there was no significant relationship between age and Bromage score. In our opinion, spinal anesthesia patients at our institution have been well managed & monitored; the selection of anesthetics in achieving the Bromage score is by considering the factors, as well as reviewing and studying previous studies so that patients can be given a dose of local anesthetic drugs taking into account age, ASA, and the complications that may occur to achieve the correct Bromage score.

This study found that patients with ASA physical status 1 are faster in achieving Bromage scores than patients with ASA physical status 2. This is in line with the research presented by Fitria et al. that in patients with ASA I, faster achievement of Bromage scores compared to patients with ASA 2.[5]

Most post-spinal anesthesia patients at our institution have the most ASA physical status, namely ASA 2, with a Bromage score of 1. The results of the analysis of the relationship between ASA physical status and Bromage score are that there is no significant relationship. According to this researcher, this is the same as the method of selecting anesthetics that have been used, appropriate and also good management in our institution. To achieve a Bromage score <2, it is seen and assessed by several factors such as age, ASA, and dose of local anesthetic drugs. The local anesthetic dose is adjusted accordingly to achieve good results based on the patient's physical ASA status.[15] This is in line with previous studies; it can be hypothesized that strict preoperative and intraoperative prophylactic measures minimize the risk of side effects (e.g., intraoperative warming or pharmacological prophylaxis for PONV and chills).[4,15] Where in the research of Sankar et al., ASA physical status (ASA-PS) is usually used to estimate preoperative health status and predict perioperative risk.[16] So, with the proper assessment of ASA's physical status, we can overcome the possible risks or complications to achieve the Bromage score properly.

The results of statistical tests showed that there was a significant relationship between gender and Bromage score in patients after spinal anesthesia. From these data, it is concluded that women get more Bromage score 3 than men, meaning that men are faster in recovering motor reflexes than women. This is in line with the research by Kasanah et al. that the motor recovery time of the lower extremities in males is faster than in females.[17] And based on Kraemer et al., this happens because of the role of androgen and testosterone hormones that men mostly own.[18] Men have about 20 times more androgens and testosterone than women. Androgen and testosterone hormones will cause men to experience motor recovery faster than women.[18]

In the study by Kraemer et al., testosterone is the primary anabolic hormone, and its concentration changes during the recovery period depending on the up or down-regulation of androgen receptors.[18] Then, the research submitted by Chae et al. shows two possible reasons for gender differences in surgical pain.[19] First, female patients had a lower pain threshold and lower tolerance for experimental pain than male patients. Regarding pain threshold and tolerance, male patients exhibited higher pain thresholds than female patients for all types of noxious stimuli. However, the most significant effect sizes were obtained between the sexes for electrical pulses and thermal stimuli. Second, hormonal variations can also lead to gender differences in the experience of pain. Gonadal hormones are known to modulate pain intensity and affect sensitivity to opioid analgesics. During the luteal phase of the menstrual cycle, a decrease in pain threshold and an increase in opioid consumption have been reported.

Other studies suggest that distinct biological differences have been hypothesized to explain gender differences in pain perception, such as fluctuations in estrogen modulating several types of pain; differences in brain function may affect sensitivity because thalamic and cortical involvement is shown in detecting and interpreting nociceptive stimuli; also differences in pain sensitivity as a function of genetics have also been demonstrated.

In addition, non-sensory or non-biological factors that have also been shown to influence pain are anxiety and pain, which are more common in women than men.[20] Females differ from men in their thermal response to exogenous and endogenous heat loss during rest and exercise due to their more excellent body-to-body mass ratio, greater subcutaneous fat content, and lower exercise capacity. These factors may influence the relationship between the female sex and the risk of shivering.[20]

The results of the analysis of the relationship between local anesthetic dose and Bromage score showed that the highest dose of local anesthetic given to patients after spinal anesthesia at our institution, namely pure bupivacaine with a dose range of 10 mg – 15.5 mg, was 182 out of 187 (97.3%) with a Bromage score of 1. It can be concluded that the average

dose of local anesthetic given to patients after spinal anesthesia is bupivacaine at a dose of 10 mg – 15.5 mg with either pure Bupivacaine or Bupivacaine + Adjuvant.

Previous studies have revealed that local anesthetics' barity, dose, volume, and concentration are important factors determining the maximal spread and sensory and motor blockade of spinal anesthesia.[21] According to a study presented by Sivaram et al., bupivacaine, when administered concomitantly with opioids such as fentanyl, low-dose bupivacaine is as effective as high-dose bupivacaine in producing adequate relaxation and analgesia.[22] Kararmaz et al. and C Olofsson et al. also did not observe a difference in motor blockade with the addition of fentanyl.[23,24] The fentanyl has different synergism with local anesthetic agents and only acts on Aδ & C fibers, so it cannot increase the motor blockade of local anesthetic agents.[23,24] In another study, fentanyl prolongs sensory blockade loss without prolonging motor block, thereby speeding recovery.[25] A lower local anesthetic dose and adjuvants are preferred for spinal anesthesia in elderly patients. The surgeon was asked to start surgery after the block level was Thoracal 10. Motor block in the lower limbs was graded according to the modified Bromage class. The prescribed intrathecal dose is considered inadequate if the block fails to rise to Thoracal level 10 within 20 minutes after intrathecal injection.

Based on research data, patients still achieved each Bromage score of 3 with a dose of bupivacaine 10 mg – 15.5 mg both with and without adjuvant at 12-45 years old. Doses of local anesthetics administered to post-spinal anesthesia patients in our institution may give good and precise results.[26] Several studies have used 25 µg of intrathecal fentanyl as an adjunct to anesthetic agents with good results and minimal side effects so that 96.9% of patients can achieve a Bromage score of 1.[27-30] Based on the results of the analysis of the relationship between the dose of local anesthetic drugs and the Bromage score, and there is no significant relationship between the dose of local anesthetic drugs and the Bromage score.[31]

The limitation of this study was that the secondary data obtained based on the anesthesia card in the medical record for post-spinal anesthesia patients do not all have complete data, so they are not included in the research subject, and further research is needed by adding other variables such as length of operation, body mass index, and surgical position.

CONCLUSION

There is a significant relationship between gender and Bromage score and no significant relationship between ASA physical status, age, and local anesthetic dose with Bromage score.

ETHICAL CONSIDERATION

This study received ethical approval from the Ethics Committee of the Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia (No:05/F7.3-UMJ/X/2021).

CONSENT FOR PUBLICATION

The patient has given informed consent to extract data from medical records and publications.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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AUTHOR CONTRIBUTION

NSR and MF were responsible for literature search, data analysis, statistical analysis, manuscript preparation, editing, and review. NSR and RK was responsible for concepts, design, the definition of intellectual content, clinical studies, data acquisition, and manuscript preparation. All authors read and approved the final manuscript.

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