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FACTORS INFLUENCING THE HEMODYNAMIC STABILITY AND ITS MANAGEMENT IN PATIENTS UNDERGOING PELVIC SURGERY UNDER SPINAL AND GENERAL ANESTHESIA

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ABSTRACT

Background: *Pelvic surgeries are complicated in term of hemodynamic instability both during and after surgery, as it is an independent predictor of long-term patient morbidity and length of hospital stay. The development of hemodynamic instability is caused by a numerous factors. When these risk factors are prevented or treated, patients may experience less hemodynamic instability during pelvic surgery, as well as the morbidity and mortality that come with it in both spinal and general anesthesia.*

Objective: *The objective of this study was to evaluate the factors that affect the hemodynamic stability and evaluate the effectiveness of different management strategies employed to ensure patient hemodynamic stability during spinal and general anesthesia.*

Method: *A multicenter cross sectional study was conducted from August 2024 to November 2024 in KP. 172 adult patients undergone pelvic surgery were included in the study. Both the patient and surgical related factors were analyzed by SPSS. Frequencies, T test and binary regression was used to correlate the factors and hemodynamic instability. The results were considered statistically significant with the p value < 0.05.*

Results: *53.5% of the patients had intraoperatively hemodynamic instability among them 59% of the patients were anaesthetize by general anesthesia and 44.8% by spinal anesthesia. Preload, type of pelvic surgery, prior medical history, ASA class II, preoperative medication, spinal anesthesia and extended procedure time were all associated with hemodynamic instability. Pharmacological management and fluid therapy employed to maintain the hemodynamic stability after instability paly important role.*

Conclusion: *Hemodynamic instability was high with associated factors like preload, type of pelvic surgery, prior medical history, ASA class II, pre-medication and spinal anesthetic. To reduce the frequency of hemodynamic instability, it was advised that susceptible patients be closely monitored, that perioperative predictors of HDI be identified and treated early.*

Keywords: *Hemodynamic instability (HDI), Spinal anesthesia, General anesthesia*

INTRODUCTION

Surgeries of the pelvic region represent quite a complex and demanding area of medical intervention often depending primarily on the selection of an anesthesia approach to ensure patient safety and optimal outcomes. With a prevalence of 19.7%, various procedures including those of the prostate, vagina, uterus, bladder, urethra, and rectum can done in the pelvic region. The muscles in the pelvic area support these organs (1)(2). Two primary methods of anesthesia frequently utilized in pelvic surgeries are spinal anesthesia and general anesthesia (3). Hemodynamic measures that are alter differentially by both spinal anesthesia and general anesthesia, including, as arterial blood oxygen saturation, heart rate, and blood pressure, are crucial considerations during perioperative period and maybe influenced by several factors including patient's demographic data, patient's medical condition, the volume pre-load, pre-medication, the expertise of the anesthetist, type of surgery and type of anesthesia. The incidence of hemodynamic instability was 59.47%, similarly 27.34%, 21.82%, 13.67%, and 15.35% were the incidence of tachycardia, bradycardia, hypotension, and hypertension respectively (4).

Spinal anesthesia is achieved to produce sensory and motor blockage, in which anesthetic drugs injected into the subarachnoid space. By blocking the activity of sympathetic nervous system, the spinal anesthesia lowers systemic vascular resistance, causes vasodilation, and may even result in hypotension (5). Conversely, general anesthesia induces unconsciousness and immobility by administering intravenous or inhaled anesthetic agents, affecting the autonomic nervous system and hemodynamic stability differently from spinal anesthesia (6). In term of hemodynamic stability inhalational induction with Sevoflurane has been reported more effective than intravenous induction with Propofol (7).

The hemodynamic response to the anesthesia, most particularly when considering operative procedures that concern the pelvis, matters significantly because of the special and rare physiological requirements of the surgical procedure itself (1). Quite often, surgical operations on the pelvis involve manipulation of visceral organs, extensive dissections of tissues and perhaps bleeding, any of which may have considerable effects on hemodynamic parameters. Understanding the factors that affecting the hemodynamic effects of spinal anesthesia versus general anesthesia and its management in patients undergoing pelvic surgery are essential for optimizing perioperative care, enhancing patient safety, and improving surgical outcomes. The available literatures suggests that regional anesthesia have some advantages as compared to the general anesthesia (8). Regardless of the critical importance there is no much data available on the hemodynamic responses related to anesthesia in pelvic surgery and in the available literature, there is very little of sample size (1)(9)(10). Surgical manipulation, tissue trauma as well as fluid shifts are some of the things that cause significant hemodynamic changes during pelvic operations leading to potential shock onset. Maintaining the proper fluid balance throughout the procedure can maintain the cardiovascular stability (11). This study was used to evaluate the factors that affect the hemodynamic stability in patients undergoing spinal anesthesia and general anesthesia during pelvic surgery and to evaluate the effectiveness of different management strategies.

METHODOLOGY

Research Design and clinical setting:

This multi-centered cross sectional study was conducted from August 2024 to November 2024 in Mardan Medical Complex KP, Akbar Medical Center KP and Ali Medical and Research Center KP.

Sample Size:

One hundred and seventy two (172) patients were selected in the study according to mentioned formula (4).

$n= (Za/2)^2 P (1-P)/E^2$

Prevalence = 19.7%, E^2 = 5%, (Za/2) = 1.96

Sampling Technique:

The participant in the study were selected by convenience sampling technique.

Participants Selection Criteria:

Inclusion Criteria:

This study included adult patients of 18 years and older, with ASA (American Society of Anesthesiologists) physical status classification I and II, and was able to give informed consent or had a legal representative to give consent. Patients with no contraindications to spinal or general anesthesia based on preoperative assessment (e.g. severe cardiovascular disease, no previous history of adverse anesthetic reactions) and scheduled for elective surgery.

Exclusion Criteria:

Patients under the age of 18, those undergone emergency surgery that required immediate attention, and those who were pregnant or breastfeeding were excluded from this study. Patients with significant coagulopathies or spinal cord disorders, which were contraindicated to spinal or general anesthesia, were also not included. Moreover, patients who had history of severe anesthesia-related adverse reactions or known allergies to anesthetic agents, those with ASA physical status III or higher, and patients concurrently involved in other clinical trials that might affect anesthesia or hemodynamic outcomes were excluded.

Ethical Consideration:

The ethical review committee approved the study and the study followed the ethical guidelines. Throughout the study, all participants provided informed consent and patient confidentiality was maintained.

Data Collection Procedure:

Data was collected from patients anesthetized by either general anesthesia using Propofal dosage of 2-2.5mg/kg IV followed by muscle relaxation by Atracurium Besylate (Acuron) 0.5 mg/kg IV and analgesia by Tramadol/Ketorolac (50-100mg IV/ 60mg IV respectively), or by spinal anesthesia between L3,L4 using Bupivacaine Sp 15mg. After the induction of anesthesia throughout the perioperative phase, the arterial blood oxygen saturation and other hemodynamic parameters, such as systolic blood pressure, diastolic blood pressure and heart rate monitored at regular interval of 15 minutes from time of induction for the next 45 minutes using the pre designed questionnaire. The questionnaire included the patient demographic data, preoperative assessment, (ASA status, preoperative medical history, premeditation, preload, type of surgery, preoperative hemodynamic status), intraoperative hemodynamic status and postoperative hemodynamic status. In addition management strategies, anesthetist experience and recovery time were included in the data collection.

Data Analysis:

Data was analyzed by SPSS, the patient demographic data and the variables related to anesthesia were analyzed and presented in the form of tables and text. To find the association between the categorical independent variables and hemodynamic instability, a Chi square test was applied while for continuous independent variables and outcome variable binary regression was applied. The p value of < 0.05 was considered significant statistically.

RESULT

This study involved 172 adult surgical patients with a 100 percent response rate. Among 43% male and 57% female the mean age was 47 (19-85) and mean weight was 74 (45-103). The preoperative physiological parameters showed systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and oxygen saturation (SpO_2) of 131.45 mmHg (SD ±13.85), 85.69 mmHg (SD ±9.73), 88.08 bpm (SD ±14.15), and 96.99% (SD ±2.18) respectively. According to the participants past medical history, 42 (24.4%) individuals had hypertension, 22 (12.8%) individuals had diabetes and 12 (7.0%) individuals had anaemia. Half (86) of the participants was ASA I and half (86) was ASA II. Among all patients 105 (61%), 67 (39%) were anesthetized with general and spinal anesthesia respectively. 54 (31.4%) patients were preloaded and the remaining 118 (68.8%) patients were not preloaded. Hemodynamic instability occurred in 92 (53.5%) patients

out of 172 (100%). Intraoperative SBP dropped right after induction (mean 129.34 mmHg, SD ±16.91) but remained within the average range for the next 45 minutes. Likewise, in the course of the procedure, intraoperative DBP and HR were nearly the same, indicating only minor changes with time. It was indicated that the SpO_2 levels have been maintained at the lowest average of ray ≥ 96.87% whole. Postoperative hypotension, hypertension, bradycardia, tachycardia and desaturation was 4.7%, 19.8%, 2.3%, 17.4% and 17.6% respectively. By analysing through Chi square test there was statistically significant association ($p < 0.05$) between the hemodynamic instability and the factors such as ASA status, past medical history, type of pelvic surgery, preoperative medication and preload while insignificant association ($p > 0.05$) was there between hemodynamic instability and patient's gender, type of anesthesia and anesthetist experience (Table 1). The binary regression shows that age of the patient, preoperative systolic BP and preoperative SpO_2 has significant variation on hemodynamic stability while the weight, preoperative diastolic BP, heart rate has no significant association on hemodynamic stability (Table 2). Among the 92 hemodynamic instable patients 5 (41.7%) patients in spinal anesthesia and 7 (58.3%) in general anesthesia received atropine, 7 (38.9%) patients in spinal anesthesia and 11 (61.1%) in general anesthesia received phenylephrine, 1 (50.0%) patients in spinal anesthesia and 1 (50.0%) in general anesthesia received lidocaine and 14 (29.2%) patients in spinal anesthesia and 34 (70.8%) in general anesthesia received labetalol. Among the patients who received crystalloid fluid therapy after hemodynamic instability 23 (60.5%) was anesthetized by general anesthesia and 15 (39.5%) had spinal anesthesia. Only one patient was treated with colloid solution who undergone general anesthesia. The result also showed that patients with intraoperative hemodynamic instability had prolong recovery time than those who were stable.

Table-1: Factors affecting the hemodynamic stability.

Table: 1					
Variables		Hemodynamic Instability		Total n (%)	P value
		No n (%)	Yes n (%)		
Gender	Male	35 (47.3)	39 (52.7)	74 (100)	0.858
	Female	45 (45.9)	53 (54.1)	98 (100)	
ASA Status	Class 1	51 (59.3)	35 (40.7)	86 (100)	0.001
	Class 2	29 (33.7)	57 (66.3)	86 (100)	
Previous Medical History	Hypertensive	13 (31.0)	29 (69.0)	42 (100)	0.000
	Diabetic	3 (13.6)	19 (86.4)	22 (100)	
	Anemic	4 (33.3)	8 (66.7)	12 (100)	
	No past History	60 (62.5)	36 (37.5)	96 (100)	
Type of Pelvic Surgery	Hysterectomy	20 (47.6)	22 (52.4)	42 (100)	0.008
	Prostatectomy	8 (23.5)	26 (76.5)	34 (100)	
	Pelvic Reconstruction	25 (47.2)	28 (52.8)	53 (100)	
	Pelvic Fracture Repair	27 (62.8)	16 (37.2)	43 (100)	
Planed Anesthesia Modality	Spinal Anesthesia	37 (55.2)	30 (44.8)	67 (100)	0.067
	General Anesthesia	43 (41.0)	62 (59.0)	105 (100)	
Anesthetist Experience	Less than 5 years	27 (38.6)	43 (61.4)	70 (100)	0.084
	More than 5 years	53 (52.0)	49 (48.0)	102 (100)	
Preoperative Medication	Anxiolytic	42 (73.7)	15 (26.3)	57 (100)	0.000
	Antihypertensive	14 (45.2)	17 (54.8)	31 (100)	

	No medicine administered	24 (28.6)	60 (71.4)	84 (100)	
Pre Load	No	15 (27.8)	39 (72.2)	54 (100)	0.001
	Yes	65 (55.1)	53 (44.9)	118 (100)	
n= frequency, %= percentage					

Table-2: The binary regression analysis of factors associated with hemodynamic instability.

Binary regression							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Age	.027	.014	4.021	1	.045	1.027
	Weight	.029	.017	2.910	1	.088	1.029
	Preop Systolic BP	.037	.018	4.326	1	.038	1.038
	Preop Diastolic BP	-.006	.024	.066	1	.798	.994
	Preop Heart Rate	.012	.014	.745	1	.388	1.012
	PreopSPO2	-.230	.089	6.644	1	.010	.794
	Constant	13.662	8.389	2.652	1	.103	857307.203
a. Variable(s) entered on step 1: Age, Weight, Preop Systolic BP, Preop Diastolic BP, Preop Heart Rate, Preop SPO2.							

DISCUSSION

Intraoperatively hemodynamic instability had developed in 92 (53.5%) out of 172 (100%) in this study, among them 59% of the patients were anaesthetize by general anesthesia and 44.8% by spinal anesthesia. The incidence of hemodynamic instability in the current study is in line with the similar studies conducted by M.M. Abebe at el (4) in which 59.47% of the patients developed instability and Mortazavi et al (12). Despite this high prevalence the difference between the both anesthesia modalities was not significant ($p>0.05$). The findings in this study showed a significant correlation between hemodynamic instability and ASA status. The patients classified as ASA II had higher risk of instability which is 66.3% than ASA I patients having 40.7% which is similar as the finding of the study conducted by M. Finsterwald at el (13), who reported that the patients with higher ASA classification are more suspected to developed hemodynamic instability during the surgery. According to the study by Deldar M at el showed that there is no significant association between type of surgery and hemodynamic instability (1) but in this study there is significant association ($p < 0.05$) with the higher rate of instability (76.5%) in prostatectomy patients among all pelvic surgeries. The difference could result from variations in patient characteristics, intraoperative fluid management, and surgical complexity between studies. The increased rates of instability among patients who have had prostatectomy emphasize the necessity of focused approaches, like careful monitoring and optimal fluid management, to maintain hemodynamic stability in this group. However, there was no apparent association between the intended anesthetic modality and hemodynamic outcomes with the p valve greater than 0.05, indicating both spinal and general anesthesia can be used successfully with appropriate patient management and monitoring that is similar with the studies (9) (10) but the result of a studies by Pierce et al (14) and M.M. Abebe at el (4) showing association between type of anesthesia and hemodynamic instability which may be due to the coexisting factors like preload, premedication and comorbidities which were not uniform in the mentioned studies. Patients undergoing general anesthesia, frequently have more complex or lengthy surgical procedures, which could cause bias into the perception of anesthetic effects. According to these results, intraoperative hemodynamic alterations are complex, and customized strategies that take procedural and patient-specific factors into account are necessary. In this study the patients who received the premedication was significantly more stable than the patients who did not received any premedication. The result is same in related to the other

studies conducted by Amornyotin S (15) and Sezen et al (16), however the use of pro-operative beta blocker was more associated with post-operative hemodynamic instability than the patients anxiolytic, the findings are similar with the result of the study in Ethiopia (4). Preoperative IV fluid administration was successful in maintaining the stable hemodynamic parameters in this study which is similar with the result of Myrberg et al (17) showing fluid therapy prior to surgery could provide a variety of physiological benefits. The frequency of blood pressure dips may be reduced by increasing preload before inducing anesthesia. The result of M.M. Abebe et al (4) showed that age of the patient, ASA status, and preoperative medication had significant association with hemodynamic instability which is same in the current study. The association between weight and hemodynamic instability was found insignificant ($p > 0.05$) in this study same as the study by Jindal P et al (18) in which weight of the patient did not display a measurable influence on the intraoperative hemodynamic stability. Similarly no change was observed in the SpO_2 at any stage of procedure but in the current study there was a little decrease in the SpO_2 (7.6%) below the normal range, this may be due the patient medical condition like preoperative anemia but there is no association between the preoperative SpO_2 and intraoperative hemodynamic instability. Researchers suggest that the use of inotropes during perioperative hemodynamic instability can improve the cardiovascular stability (19), same in the current study the instability during spinal and general anesthesia was treated with phenylephrine and atropine in the titrated dose and labetalol was used to treat hypertension. Among the patients who received crystalloid fluid therapy after hemodynamic instability 60.5% was anesthetized by general anesthesia and 39.5% had spinal anesthesia and only one patient was treated with colloid solution who undergone general anesthesia according to the suggestion of the Hayakawa (20). In the current study the incidence of post-operative tachycardia, bradycardia, hypotension, and hypertension was 17.4%, 2.3 %, 4.7 % and 19.8% respectively which is different from a study in Ethiopia in which the tachycardia, bradycardia, hypotension, and hypertension was 27.34%, 21.82%, 13.67% and 15.35% respectively (4). The difference may be due to the difference in the sample size in the studies. Another study in Libya presented the rate of hypertension (12%), hypotension (8%), tachycardia (25%), and bradycardia (1%). This might be due to low staff available in the recovery room or post anesthesia care room which make challenging to recognize the hemodynamic instability and may also be due to the anesthetist experience. In the current study there was significant association between the intraoperative hemodynamic instability and the recovery time. The patients who were hemodynamic stable recover considerably faster (mean = 7.29 ± 3.54 hours) than patients with hemodynamic instability (mean = 11.52 ± 3.17 hours), suggesting that hemodynamic instability lengthens recovery time in the patients undergoing pelvic surgery which is similar in the study conducted by M. Finsterwald at el (13).

LIMITATIONS OF THE STUDY

All the hemodynamic parameters were recorded using noninvasive devices that may not displayed the particular reading which can be achieved by using invasive devices. The sample size in this study was small.

CONCLUSION

The frequency and contributing factors that contribute to hemodynamic instability in pelvic surgery are critically examined in this study. In general, hemodynamic instability was quite high. Preload, type of pelvic surgery, prior medical history, ASA class II, preoperative medication, use of regional anesthetic, and extended procedure time were all associated with hemodynamic instability. Pharmacological management and the use of fluid therapy employed to maintain the hemodynamic stability after the hemodynamic instability paly important role. To reduce the frequency of hemodynamic instability, it was advised that susceptible patients be closely monitored, that perioperative predictors of HDI be identified and treated early. This research highlights the multifaceted nature of hemodynamic instability and advocates for a care approach that involves careful preoperative assessment, attentive intraoperative monitoring, and personalized treatment. Additional research may uncover ways to decrease the frequency and severity of hemodynamic instability in pelvic surgery patients by examining specially designed regimens for those with high risk.

Disclosure

The authors report no conflicts of interest in this study.

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