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"IMPACT OF OXYTOCIN ON HAEMODYNAMIC CHANGES DURING CESAREAN SECTION WITH SPINAL ANESTHESIA"

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ABSTRACT

Background: Oxytocin is commonly used in obstetrics as a uterotonic drug for the induction and augmentation of labor, and it remains the preferred agent for facilitating uterine contractions during both vaginal and operative deliveries. Its administration is becoming more widespread, even in remote areas. The infusion method of oxytocin is considered safe during cesarean sections under spinal anesthesia.

Objective: This study aims to evaluate the hemodynamic modifications induced by oxytocin given as an infusion to manage uterine bleeding during cesarean sections.

Methods: This prospective observational study was conducted in a teritiary care hospital .A total of thirty patients in which each parturients received 10 IU of oxytocin as infusion in 100ml of normal saline administered I/V over five minutes . The study duration began just before oxytocin administration and continued for an additional 10 minutes. Systolic and diastolic blood pressure (BP) and heart rate were recorded in 0 min, 2min, 5min 10min.

Results: All outcomes are expressed as mean ± standard deviation. The study group was statistically analysed in terms of age, heart rate, systolic and diastolic blood pressure. Significant differences in all hemodynamic parameters were observed between 2 to 5 minutes after oxytocin administration ($p < 0.05$).

Conclusion: Oxytocin remains the first line uterotonic agent after vaginal and cesarean deliveries. The hemodynamic changes were more pronounced with respect to diastolic blood pressure and heart rate during and second- and fifth-minute during oxytocin infusion. A slower administration of oxytocin can effectively minimize cardiovascular side effects while adequately reducing blood loss without compromising therapeutic benefits.

KEYWORDS: Oxytocin, Infusion, Hemodynamic, Intravenous.

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INTRODUCTION

Oxytocin is the most widely used uterotonic agent in obstetrics, routinely administered after both normal and operative deliveries to promote adequate uterine contractility, reduce blood loss, and prevent postpartum hemorrhage[1]. Various regimens of oxytocin during cesarean delivery (CD) have been explored, yielding both desired (uterotonic) and undesired (cardiovascular) effects[2-8]. Typically, oxytocin is given as an intravenous (IV) bolus followed by an IV infusion to ensure effective uterine contractions. However, rapid administration of larger doses can lead to several adverse effects, including hypotension, nausea, vomiting, chest pain, headache, flushing, myocardial ischemia, ST-T segment changes, pulmonary edema, severe water intoxication, and convulsions[9]. These potential complications highlight the need for careful dosing and monitoring during administration.

The aim of the study was to analyze the hemodynamic effects of intravenous (IV) infusion of oxytocin, focusing on key parameters such as heart rate, systolic blood pressure, and diastolic blood pressure. This analysis seeks to understand how oxytocin administration influences cardiovascular stability during its use in obstetric settings, particularly in relation to the potential adverse effects associated with its rapid administration.

MATERIALS AND METHODS

This prospective observational study was conducted after obtaining written informed consent from all participants. A total of thirty parturients, classified as American Society of Anesthesiologists (ASA) physical status II, aged between 20 and 40 years, were recruited for elective cesarean delivery (CD) under spinal anesthesia. The sample size of 30 was determined based on calculations from a previous study. Patients were excluded from the study if they had active labor pain, ruptured membranes, multiple gestation, cardiovascular instability, preeclampsia, eclampsia, diabetes mellitus, or placenta previa. This careful selection aimed to ensure a homogenous study population for assessing the hemodynamic effects of oxytocin IV infusion.

Patients were instructed to avoid solid food for 6 hours prior to the procedure and allowed to drink plain water up to 2 hours before surgery. Upon arrival in the operating room, an IV line was established using an 18G cannula, and preloading with Ringer's lactate solution was administered at a rate of 15 ml/kg over 30 minutes before spinal anesthesia (SA). This was followed by a continuous infusion of the same solution at 5 ml/kg/hour. All patients received premedication with 10 mg of metoclopramide and 50 mg of ranitidine via IV. Baseline measurements of heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were recorded prior to the administration of spinal anesthesia, and the SA procedure was explained to each patient.

Hyperbaric bupivacaine (0.5%) was administered at a dose of 2ml through the L3-L4 intervertebral space using a 25-G Quicke’s spinal needle, with patients in a sitting position. After the injection, patients were positioned supine with left lateral uterine displacement using a wedge

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to optimize uterine blood flow. A multipara monitor was attached to continuously monitor vital signs. Surgery commenced once a T6 sensory level was confirmed via pinprick assessment. Following childbirth, oxytocin was administered as Iv infusion. Systolic blood pressure , diastolic blood pressure and heart rate (HR) were recorded again prior to the administration of oxytocin. Heart rate (HR) was measured 2 minutes after the administration of oxytocin, with subsequent measurements taken at 5 and 10 minutes.The Hypotension was managed with fluid boluses and Injection Ephedrine 6mg IV boluses.

Patient characteristics, along with obstetric and intraoperative data, were presented as mean ± standard deviation (SD). Numerical data were analyzed using the Student's t-test, while categorical data were assessed with the Chi-square test. A P value of less than 0.05 was deemed statistically significant. The collected data were entered into a Microsoft Excel database and analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 12.0. This statistical approach allowed for a thorough examination of the findings.

RESULTS

Table 1: Variation in heart rate 2min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE	**HR AT 0MIN**	30	93.5	92.5	7.17	1.31
	HR AT 2 MIN	30	103	103	7.72	1.41

Table 2:Variation in Systolic blood pressure 2min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (2)	**0 MIN(SBP)**	30	114	115	8.39	1.53
	2MIN(SBP)	30	104	103	8.58	1.57

Table 3: Variation in Diastolic blood pressure 2min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (3)	**0 MIN DBP**	30	70.5	70.0	6.64	1.21

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Table 3: Variation in Diastolic blood pressure 2min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
	2MIN DBP	30	63.5	63.5	6.64	1.21

Table 5: Variation in heart rate 5min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (4)	**HR AT 0**	30	93.5	92.5	7.17	1.31
	HR AT 5	30	107	107	7.64	1.40

Table 5: Variation in systolic blood pressure 5min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (5)	**0 MIN(SBP)**	30	114	115	8.39	1.53
	5MIN(*SBP)	30	93.8	92.0	7.70	1.41

Table 6: Variation in diastolic blood pressure 5min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (6)	**0 MIN DBP**	30	70.5	70.0	6.64	1.21
	5MIN DBP	30	59.8	60.5	6.16	1.12

Table 7: Variation in heart rate 10min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (7)	**HR AT 0**	30	93.5	92.5	7.17	1.31
	HR AT 10	30	97.7	96.5	6.35	1.16

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Table 8: Variation in systolic blood pressure 10min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (8)	**0 MIN(SBP)**	30	114	115	8.39	1.53
	10MIN(SBP)	30	99.2	97.5	7.53	1.37

Table 9: Variation in diastolic blood pressure 10min following oxytocin infusion

	Group	N	Mean	Median	SD	SE
VALUE (9)	**0 MIN DBP**	30	70.5	70.0	6.64	1.21
	10MIN DBP	30	69.3	70.0	7.05	1.29

Table 10: Variation of all haemodynamic variable in 0min, 2min, 5min and 10min following oxytocin infusion

	HR 0 MIN	2MIN	5MIN	10 MIN	0 MIN (SBP)	2MIN(SBP)	5MIN (*SBP)	10MIN(SBP)	0 MIN DBP	2MIN DBP	5MIN DBP	10 MIN DBP
N	30	30	30	30	30	30	30	30	30	30	30	30
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean	93.5	103	107	97.7	114	104	93.8	99.2	70.5	63.5	59.8	69.3
Median	92.5	103	107	96.5	115	103	92.0	97.5	70.0	63.5	60.5	70.0

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Table 10: Variation of all haemodynamic variable in 0min, 2min, 5min and 10min following oxytocin infusion

	HR 0 MIN	2MIN	5MIN	10 MIN	0 MIN (SBP)	2MIN(SBP)	5MIN (*SBP)	10MIN(SBP)	0 MIN DBP	2MIN DBP	5MIN DBP	10 MIN DBP
Standard deviation	7.17	7.72	7.64	6.35	8.39	8.58	7.70	7.53	6.64	6.64	6.16	7.05
Minimum	81	89	94	88	100	92	83	89	58	52	50	60
Maximum	111	121	126	114	128	120	114	118	82	78	74	90

In case of infusion group heart rate increased by about 10 beats per minute at around 60 seconds of starting infusion, gradually decreased to almost basal level at 10 minutes.

DISCUSSION

Pregnant women undergoing cesarean delivery (CD) are at an elevated risk of obstetric hemorrhage, primarily due to uterine atony[1]. Oxytocin is the primary treatment for addressing uterine atony. Prophylactic use of oxytocin has been shown to reduce the incidence of postpartum hemorrhage by up to 40%[10]. Despite its widespread use, there is limited data available to establish optimal dosing guidelines for oxytocin in patients undergoing elective CD. This gap in knowledge highlights the need for further research to determine effective dosing strategies that balance efficacy and safety.

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During pregnancy, the population of uterine oxytocin receptors increases progressively, peaking at term. In late pregnancy, prior to labor, the number of oxytocin receptors is approximately 12 times higher than in early pregnancy and about 80 times higher than in a non-pregnant uterus. This heightened sensitivity in the non-laboring uterus at term suggests that a low dose of oxytocin may achieve optimal efficacy without the adverse effects associated with higher doses. In this study, we specifically selected mothers undergoing elective cesarean delivery who were not in labor, anticipating a favorable response to low doses of oxytocin.[9]

During the onset of labor, uterine sensitivity to oxytocin increases, with oxytocin receptors being expressed diffusely and heterogeneously[9]. It is common practice to escalate the dose of oxytocin under the assumption that higher doses will lead to more effective uterine contractions. However, in laboring mothers who are already receiving oxytocin during cesarean delivery (CD), higher doses are unlikely to enhance uterine contractions further.

In both in-vitro and in-vivo studies, prior exposure to oxytocin has been shown to induce myometrial oxytocin receptor desensitization[1], which depends on the duration of exposure and typically occurs within a clinically relevant timeframe of approximately 4.2 hours[11]. This desensitization can significantly influence the optimal dosing of oxytocin needed to achieve adequate uterine tone following cesarean delivery, as the dose required in laboring women is nine times higher than that needed in non-laboring women.[5]

The present study observed a significant increase in heart rate (HR) of approximately 5-10 beats per minute in the study group at 5 minutes post-administration of oxytocin. This increase returned to baseline gradually after 10 minutes. Also there was significant decrease in Systolic and Diastolic blood pressure at 5minutes following administration of Oxytocin infusion which returned to baseline gradually following administration of fluid boluses and Injection Ephedrine 6mg IV bolus at 10minutes.

CONCLUSION

Our study concluded significant increase in heart rate at 5 minutes and decrease in systolic and diastolic blood pressure at 5 minutes following administration of oxytocin infusion after cesarian section which could be adequately managed without complications.

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