COMPARISON OF HAEMODYNAMIC EFFECTS OF EQUIVALENT DOSE OF OXYTOCIN GIVEN AS BOLUS AND IN INFUSION

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ABSTRACT

Objective: To compare the haemodynamic effects of equivalent dose of oxytocin given as an intravenous bolus and as infusion.

Study Design: Randomized controlled trial.

Place and Duration of Study: CMH Rawalpindi from Jan 2016 to Jul 2016.

Material and Methods: This randomized control trial was conducted after approval of ethical committee of the hospital and a total 90 patients, American society of anesthesiologists physical status I or II, were included in this study. Patients were divided into two groups (n=45), group-A received oxytocin (5 IU) approximately over 10 seconds as an intravenous bolus and group-B received (5 IU) over 5 minutes as an infusion in infusion pump. Mean heart rate and mean blood pressure recorded at Baseline 0, 1, 5, 10 and 15 minutes. The hemodynamic data was compared between the groups.

Results: The Oxytocin when administered as an intravenous infusion showed statistically significant effects on heart rate when compared with bolus group from 1 minute to 15 minute (p<0.001). Similarly, oxytocin once administered as an intravenous infusion showed statistically significant difference in mean arterial pressure (MAP) when compared with bolus group from 1 minute to 15 minute (p<0.001).

Conclusion: It is concluded that oxytocin (5IU) once administered as an infusion during elective caesarean section causes less haemodynamic changes.

Keywords: Cesarean section, Hemodynamics, Oxytocin.

INTRODUCTION

Caesarean section is one in every of the foremost commonly performed surgical procedures in women throughout the globe[1]. These surgical procedures have escalated over the past four decades to 20% and 30% in developed countries[1], 25.9% in China and 7.3% in Pakistan[2]. Post partum haemorrhage has been thought of as a leading reason for maternal morbidity and mortality and conjointly had a robust associations with anemia, risks of transfusion, hysterectomy, and in severe cases, maternal death[1]. Among different causes of PPH, uterine atony constitutes 45.9% and thought of as the leading reason for maternal mortality worldwide[3]. Oxytocin is used habitually in obstetrics as an uterotonic agent[4]. It is administered to initiate and maintain adequate uterine contractions in order to attenuate blood loss and to prevent postpartum hemorrhage after normal and operative delivery[4]. The therapeutic blessings of oxytocin observed at vaginal birth, may also apply to the caesarean section[4]. Different doses of oxytocin have been studied with variable desirable and undesirable effects during cesarean deliveries[4]. The desirable effects of oxytocin is to minimize blood loss while maintaining a state of adequate uterine contraction and its undesireable effects includes chest pain, hypotension, tachycardia, nausea, vomiting, headache, flushing, myocardial ischemia, ECG changes, pulmonary edema, severe water intoxication, and convulsion[4,5]. In different literature, the optimum dose of oxytocin which is administered routinely as an intravenous bolus at the time of delivery of fetus in caesarian section is 5 IU[6]. Intravenous bolus administration of oxytocin may result in maternal hypotension, cardiac

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arrhythmias which may lead to myocardial ischemia[7,8]. These hemo-dynamic changes are well tolerated in normal individuals but are of greater significance in patients with co morbidities like hypertension and conditions associated with poor cardiac reserve[9]. We conducted this study in our center to find and adopt a safer way of giving oxytocin after caesarian delivery with minimal haemodynamic effects.

MATERIAL AND METHODS

This prospective, comparative, double blind randomized controlled study (RCT) was carried out over a period of six months from Jan 2016 to Jul 2016 in the department of anaesthesiology CMH Rawalpindi, a tertiary care hospital after approval of the hospital ethical committee and informed written consent after explaining the risks and benefits to the patients. Open epi sample size calculator was used for sample size calculation with 95% confidence interval and absolute precision of 0.05. The absolute population means in group1 and in group 2 were 17 ± 10.7 and 10 ± 9.7 respectively[10] calculated sample size (n) was 45 in each group and a total of 90[4]. All patients with ASA (American society of anesthesiologist) physical status of I-II between the ages 25 to 45 undergoing elective caesarean sections were included in this study. Non probability consecutive sampling technique was used. Patients with the history and diagnosis of placenta previa, placenta accreta, twin pregnancy, pregnancy with fibroid uterus, hypertension, pre-eclampsia and eclampsia were excluded from the study. Patients were randomly allocated into two groups using computer generated report. The anesthetic techniques and standard monitoring applied were same for all patients (blood pressure monitoring, pulse oximetry and ECG). All the patients were preloaded with 500ml of lactated ringer solution before spinal anesthesia (subarachnoid block). In all patients, subarachnoid block was established at L4/5 interspinous space in sitting position with 25G pencil point spinal needle by using hyperbaric bupivacaine 0.75% (1.5ml). Surgery was allowed to start after confirming the adequacy of block. Hypotension was treated with IV phenylephrine 50-100mcg boluses aiming to restore mean arterial pressure within 20% of baseline values. In group-A, oxytocin administered just after delivery of foetus, as a bolus of 5 IU given approximately over 10 s and in group-B, 5 IU oxytocin diluted to 20ml normal saline and given over 5 minute through an infusion pump. For both groups mean arterial pressure (MAP) and mean heart rate were recorded at baseline 0 (before oxytocin infusion), 1, 3, 5, 10, 15 minute (after oxytocin infusion) and values at 0, 1, 3, 5, 10, 15 minutes was compared between both the groups. Mean ± SD was calculated and p-value<0.05 was considered significant. Data recorded were analyzed using statistical package for social sciences (SPSS) version 20.0. Mean and standard deviation were calculated for quantitative variable as age, heart rate and mean arterial blood pressure and qualitative data i.e. gender and ASA status was presented as frequency and percentages. Chi square test was used for qualitative variables and independent sample't' test was used to compare means in group A & B. A p-value <0.05 was considered significant.

RESULTS

Regarding age distribution, majority of the patients were between 20-30 year. Mean age of the patients in group-A and group-B were, 27.8 ± 3.6 and 28.5 ± 3.1 respectively. Most of the patients belonged to ASA-I in group-A, 38 (84.4%) and in group-B 36 (80.0%) respectively. (table-I). In group-A (bolus group), the maximum rise of mean heart rate was at 3 min, which was 21.9 ± 3.16 (mean diff) beats/min from baseline, even at 15 min mean heart rate remained higher than baseline and did not touch the baseline i.e. 6.5 ± 0.3 (difference b/w 0 min and 15 min). In group-B (infusion group), the maximum rise of mean heart rate was at 3 min, which was 9.3 ± 3.3 beats/min from baseline, at 15 min mean heart rate touched the baseline. Table-II. In group A, the maximum decrease in mean blood pressure from baseline was observed at 1 min (after bolus)

i.e. 21.7 ± 1.9 mmHg (mean diff) and mean blood pressure returned near to baseline after 5 minutes of IV bolus. Similarly, in group B, the maximum decrease in mean blood pressure from baseline was observed at 1 min (after infusion) i.e. 8.7 ± 0.8 mmHg (mean diff) and mean blood pressure returned near to baseline at 10 minutes with the least haemodynamic variations (table-III).

DISCUSSION

Pregnant women undergoing cesarean deliveries are prone to develop obstetrical hemorrhage due to uterine atony[9]. Oxytocin is the treatment of choice for uterine atony[1]. The incidence of postpartum hemorrhage is decrease by up to 40% by prophylactic use of oxytocin[10]. There is limited accessible knowledge to guide the optimal oxytocin dose in patients undergoing elective cesarean deliveries despite extensive use of oxytocin. Various adverse effects have been documented on fast and speedy bolus of oxytocin such as nausea, vomiting, chest pain, headache, flushing, hypotension, myocardial ischemia, ECG changes, pulmonary edema, and severe water intoxication with convulsions[9]. The result of our study showed that slower administration of oxytocin can successfully lessen the cardio-vascular adverse events of a bolus dose. In our study, an average decrease in MAP from baseline was 21.7 ± 1.9 (mm Hg) and average increase in heart rate was 21.9 ± 3.16 (beats/min) in healthy women who underwent an elective caesarean section and received 5 IU of oxytocin as a rapid bolus. In young healthy patients, this extent of decrease in MAP and increase in HR could be well tolerated more often but it may not be desirable if there is associated severe blood loss or perhaps once there is unsuspected decrease myocardial reserve. Haemodynamic changes after caesarean deliveries have several potential reasons, including removal of aorto-caval compression, autotransfusion from uterine contraction, blood loss and use of vasopressors[11]. The cardiovascular changes ascertained after oxytocin administration are mainly dose-related

Table-I: Distribution of cases by Age and ASA status.

Patient Parameters	Group A	Group B	*p*-value
Age (Mean ± SD)	27.8 ± 3.6	28.5 ± 3.1	0.33
ASA Level	38/07	36/09	0.17
ASA I / ASA II	84.4%/ 15.6%	80%/20%	
n=90	n=45	n=45	

Table-II: Effect of oxytocin on Heart rate (beat/min) administered intravenous bolus vs infusion.

Time (min)	Group-A (Bolus)	Group-B (Infusion)	*p*-value
0	79.1 ± 4.22	80.0 ± 3.8	0.29
1	97.4 ± 8.28	88.3 ± 5.10	0.0001
3	101.0 ± 7.38	89.3 ± 6.18	0.0001
5	99.48 ± 5.90	85.8 ± 7.10	0.0001
10	89.53 ± 5.25	80.0 ± 4.63	0.0001
15	85.6 ± 7.9	79.2 ± 4.7	0.0001

Table-III: Effect of oxytocin on Mean arterial pressure administered intravenous bolus vs infusion (MAP in mmHg).

Time (min)	Group-A (Bolus)	Group-B (Infusion)	*p*-value
0	73.2 ± 7.1	74.4 ± 3.5	0.31
1	51.5 ± 5.2	65.7 ± 2.7	0.0001
3	62.7 ± 3.9	68.5 ± 4.5	0.0001
5	74.0 ± 4.1	73.2 ± 3.7	0.33
10	78.2 ± 3.9	74.6 ± 4.3	0.0001
15	79.8 ± 2.7	76.0 ± 0.7	0.0001

decrease in mean arterial pressure because of peripheral vasodilation, with a compensatory increase in HR and cardiac output as a consequent[7]. The results of our study are consistant with different studies, as Susmita Bhattacharya *et al*, observed significant rise in heart rate and decrease in mean arterial pressure in bolus group compared to infusion group[4]. The heart rate increased by 25-30 beats/minute in bolus group at 30 seconds, remained up to 120 seconds and gradually decreased but did not touch the basal value even at 10 minutes. In case of infusion group, heart rate increased by about 10 beats per minute at 60 seconds of starting infusion, gradually decreased to almost basal level at 10 minutes. The values of mean heart rate of bolus group were higher compared to infusion group. However, the bolus regime shows significantly more adverse cardiovascular events[4]. Similarly JS. Thomas *et al*, observed marked cardiovascular changes in the bolus group; the heart rate increased by 17 ± 10.7 beats min (mean (SD) compared with 10 ± 9.7 beats min in the infusion group. The mean arterial pressure decreased by 27 ± 7.6 mmHg in the bolus group compared with 8 ± 8.7 mm Hg in the infusion group and recommended that bolus doses should be used with caution[10]. Recent obstetric practices do not recommend the use of bolus intravenous oxytocin for prophylaxis against postpartum hemorrhage as it may cause unexpected hypotension[11]. Our data supported the results from previously published trials and established the haemodynamic stability of oxytocin infusion (5 IU) in healthy parturients during caesarean sections[1,4,8,10]. Delivery itself may contribute to the circulatory changes, but the effects of oxytocin cannot be overlooked. An implication of the findings reported here is that administration of oxytocin 5 IU as a bolus should probably be discouraged since the large swings in haemodynamics could be hazardous to susceptible parturients. An infusion, or smaller repeated doses, might be an improved alternative. The cardiovascular effects of oxytocin have been studied antecedently however the degree to which this haemodynamic instability took place has been studied during this study. Our study established decrease in MAP and associated increase in heart rate in healthy women after an elective caesarean section who received 5 IU of oxytocin as a rapid bolus. There was a decrease in MAP of less than 45 mm Hg in five patients. The women in our study took quite 5 minutes for her MAP to come back almost near to baseline after the oxytocin injection in both groups but in bolus group this decline was maximum at 1 minute and significant, whereas in infusion group this decline was negligible and insignificant. There were only three patients with the complaints of nausea or vomiting throughout this reduction in MAP in bolus group. The changes in HR were also considerably and completely different in the two groups. This decrease in MAP and increase in HR could be well tolerated normally; it may not be desirable if there is associated severe blood loss or when there is unsuspected myocardial disease.

CONCLUSION

Our findings showed that the addition of an oxytocin infusion at elective caesarean section considerably reduces unwanted effects of oxytocin. An oxytocin infusion is an economical, well tolerated, and somewhat safe medication which, when used routinely, avoids significant hemodynamic changes. Our findings support the use of oxytocin infusion, this approach could be implemented safely and rationally into current clinical practice.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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