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# IMPACT OF OXYTOCIN ON HEMODYNAMIC CHANGES DURING CESAREAN SUCTION UNDER SPINAL AND GENERAL ANESTHESIA

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## Abstract

**Background:** The best drug of choice for uterine contraction following cesarean section is oxytocin. But this could also associate with some hemodynamic changes. These changes caused by oxytocin include hypotension, decrease cardiac output and tachycardia. In a high-risk patient these can be sufficient to compromise their health status. In a rare case it may also cause death.

**Objectives:** This study aims to minimize the risks associated with oxytocin administration while maximize its therapeutic benefits i.e. to control postpartum hemorrhage following cesarean section and to contract uterine more effectively.

**Method**: Total 180 subjects were included in the study. We divided randomly these subjects into two groups i.e. group A and group B. Both groups contain equal number of subjects i.e. 90 subjects per group. Group a received 5 IU of IV oxytocin as bolus over 3 seconds. In contrast group B received 5 IU of IV oxytocin as infusion (infusion dose was diluted 10 mL of distilled water) within 3 minutes.

**Results:** From results we observe that there is marked increase in heart rate and decrease in blood pressure following IV administration of oxytocin as IV bolos as compared to slow IV infusion of oxytocin. Although no variations were observed in blood loss between these groups.

**Conclusion:** Hemodynamic changes are greatly associated with the use of oxytocin as IV bolos. While administration of oxytocin as IV infusion don't compromise cardiovascular system. IV infusion is well tolerated and better choice of administering oxytocin than IV bolos in control of postpartum hemorrhage.

## 1) INTRODUCTION

### General Anesthesia in Cesarean Section

Anesthesiologists must select either general or regional anesthesia based on the specific clinical condition and needs of each patient. The appropriate choice of anesthesia during a cesarean section is crucial not only for minimizing maternal and

fetal complications but also for preventing intraoperative maternal awareness.[1]In most countries throughout the world, obstetric hemorrhage is the most common and lethal side effect
of pregnancy.[2]

## Spinal Anesthesia in Cesarean Section

Spinal anesthesia is generally preferred for cesarean sections due to its lower risk of airway complications, aspiration, intraoperative awareness, and reduced uterine atony, which can lead to excessive blood loss. General anesthesia is typically reserved for cases where neuraxial anesthesia is contraindicated, when the neuraxial technique fails, or when a patient requests it for an elective cesarean section[4].While the positive effects of neuraxial anesthesia on newborns are well-documented.[5]

### Cesarean Section

A surgical procedure in which a newborn is deliver through incision made in parturient abdomen along with uterus. It may often necessary when vaginal or natural delivery is not possible or poses significant risks. This procedure can be crucial for saving the lives of both the mother and the infant in emergency situations. It offers a safer alternative when complications arise during labor.[7] About 10% of all deliveries are deemed high-risk, and some of these may require a cesarean section.[8]

Few past years, the global incidence of Cesarean sections has risen significantly, especially in high- and middle-income countries.[9]

### Postpartum Hemorrhage

Postpartum hemorrhage (PPH) is historically defined as the loss of blood more than 500 mL after a vaginal or natural delivery or more than 1000 mL following a cesarean section[11]It is one of the most frequent complications associated with cesarean births. Other definitions of PPH include a significant drop in hematocrit levels by 10 percentage points or more, or the need for a blood transfusion due to blood loss.[12]

### Role of Oxytocin in Control of Postpartum Hemorrhage

Oxytocin is typically given intravenously after the baby is delivered during a cesarean section to reduce blood loss. When administered as a rapid bolus, it causes noticeable vasodilation in both arteries and capacitance vessels.[13] This helps decrease the risk of hemorrhage by enhancing uterine contraction and controlling bleeding. Its use is essential for managing post-surgical blood loss. The quick onset of action makes oxytocin a vital part of postpartum care.[14]

### AIM

This study aims to determine the adverse effects on maternal hemodynamic caused by oxytocin.

### RATIOANLE:

Although Cesarean section is a common surgical procedure, and oxytocin is commonly using drug in control of postpartum hemorrhage. Previous studies has shown the comparison of oxytocin with other uterotonic drugs using routinely, which highlights the hemodynamic changes caused by oxytocin. Therefore our study focused on mean hemodynamic parameters which is influenced by oxytocin in Cesarean section under spinal and general anesthesia.

**SIGNIFICANCE:**

This study is significant since it shows the use of oxytocin in such way that it causes significant uterus contraction without interrupting its therapeutic benefits. This research study clarifying that infusion of oxytocin is more suitable and well tolerated than the bolos of IV oxytocin.

## 2-Materials and Methods

The design of this study was based on observational cross-sectional.All the data were collected at Northwest General Hospital and Research Center Peshawar. The period of the study was six months. This timeframe helped to capture more than enough data on the busy schedules and availability of cases of cesarean section at Northwest General Hospital and Research Center Peshawar. 180 patients were selected among the population presented for C-Section in Northwest General Hospital and Research Center Peshawar. With the help of Open epi calculator, we calculated our sample size with; 95 level of confidence, 5% margin of error, Prevalence 35%, Population size 185,767 (according to recent census 2024, Peshawar). Convenience sampling technique was used with inclusion criteria of age 18-45 years, patients undergoing cesarean section, patients undergoing both spinal and general anesthesia, ASA I, and II patients, weight less than 100 kg, and excluded the patients having age <18 years, natural or vaginal delivery, history of hypertension, patients on anti-hypertensive therapy and congenital anomalies i.e. mitral stenosis, aortic regurgu etc. This study was carried out following approval from the Ethical Committee of Northwest General Hospital and Research Center Peshawar. All The protocols were rigidly defined and 180 patients (90 in each group) according to the dose of oxytocin given to parturient i.e. 5 IU bolus (Group A) and IV 5 IU infusion (Group B). The assessment of the patients was done preoperatively. Exclusion of the patients with cardiac abnormalities and drugs using routinely was based on the history and preoperative investigation results. Instruments that were used in the study included non-invasive blood pressure machine for BP measurements, ECG leads for heart rate, pulse oximeter of the measurement of oxygen saturation and displaying monitor to show all hemodynamic parameters. These groups were randomly selected. All hemodynamic were monitored preoperatively and noted in data collection Performa at 0 minute known as baseline readings. After newborn delivering following clamping of umbilical cord 5 IU of oxytocin IV bolus about (3 seconds) were given to group A and 5 IU of oxytocin slow infusion IV (which was diluted in 10 mL of distilled water) were given to group B over 3 minutes. Following oxytocin administration all the hemodynamic parameters were recorded separately for group A and group B at 2, 3 and 5 minute. This 2, 3 and 5 minutes were selected on the base of oxytocin's half-life, because oxytocin's half-life is approximately up to 5 minutes. The surgeon observed the patients and the contraction of the uterus was stated as mildly, moderately and fully contracted. The blood loss was estimated visually using surgical sponges and laparotomy pads. A fully soaked 4" × 4" sponge on each side can absorb 10 mL of

blood, while a soaked laparotomy pad (lap) holds 100-150 mL. In the case of a cesarean section, a blood loss of 800-1000 mL is considered as tolerated, any blood loss exceeding 1000 mL is considered excessive. The data collected was analyzed using SPSS software version 27 and the statistical approach was defined according to the other health relevant studies and suitable tests, after getting the required data collected were applied. The results were collected and analyzed using statistical methods, including the unpaired t-test and chi-square test, with a significance level set at a p-value of less than 0.05.

**3-RESULTS**

We obtained a total of 180 data of subjects. Table 1 presents the distribution of age, gestational age, and weight of the subjects. Table 2 compares the mean hemodynamic parameters between Group A and Group B at the 0-minute mark. Table 3 compares the mean hemodynamic parameters between Group A and Group B at 3 minutes. Table 4 compares the mean hemodynamic parameters between Group A and Group Bt 5 minutes.

Table 1: Age of patient, age of pregnancy and weight division of the patients

| | Group A n=90 Mean ± SD | Group B n=90 Mean ± SD | t values | p values |
|---|---|---|---|---|
| Age of pts(yrs) | 25.2±7.0 | 25.1±5.6 | 0.7 | 0.487 |
| Age of pregnancy (weeks) | 39.2±0.8 | 39.1±0.9 | 0.921 | 0.360 |
| Pt's wt (kg) | 60.4±4.0 | 60.1±3.2 | 0.98 | 0.412 |

Group A received a 5 IU oxytocin bolus, while Group B received a 5 IU oxytocin IV infusion. The p-value for age and weight of the patients was determined using an unpaired t-test, and the p-value for age of pregnancy was calculated using the chi-square test. No significant difference was observed between Group Aand Group B . Table2: Comparison of the mean hemodynamic parameters between Group A and Group B at the 0-minute mark.

| 0 min | Group A (n=90) Mean ± SD | Group B (n=90) Mean ± SD | t values | p values |
|---|---|---|---|---|
| Heart rate (beat/min) | 89.5±8.4 | 86.9±9.5 | 0.73 | 0.471 |
| Systolic BP (mmHg) | 116.7±7.5 | 119.7±6.7 | 1.63 | 0.109 |
| Diastolic BP (mmHg) | 75.7±6.8 | 77.8±4.9 | 1.42 | 0.160 |
| $SPO_2$(%) | 97.7±0.6 | 98.0±0.6 | 1.71 | 0.093 |
| MAP(mmHg) | 88.9±7.0 | 86.8±4.4 | 1.93 | 0.059 |

Group A received a 5 IU oxytocin bolus, while Group B received a 5 IU oxytocin IV infusion. The p-value was calculated using an unpaired t-test. The mean differences in all hemodynamic parameters at the 0-minute mark were not statistically significant ($p > 0.05$) according to the unpaired t-test

Table 3: Comparison of hemodynamic mean parameters between Group A and Group B at 3 minute

| 3 minutes | Group A n=90 Mean ± SD | Group B n=90 Mean ± SD | t values | p values |
|---|---|---|---|---|
| Heart rate (beats/min) | 105.8±5.2 | 90.1±2.1 | 2.27 | 0.026 |
| Systolic BP (mmHg) | 95.5±5.4 | 108.7±4.3 | 2.16 | 0.006 |
| Diastolic BP (mmHg) | 0.0±9.9 | 73.7±8.1 | 2.39 | 0.022 |
| $SPO_2$(%) | 98.7±0.5 | 98.8±0.5 | 0.25 | 0.802 |
| MAP(mmHg) | 65.2±6.3 | 73.7±7.2 | 2.07 | 0.03 |

Group A received a 5 IU oxytocin bolus, while Group B received a 5 IU oxytocin IV infusion. The p-value was determined using an unpaired t-test. The mean differences in all hemodynamic parameters at the 3-minute mark were statistically significant ($p < 0.05$), except for SPO2, which showed no statistically significant difference ($p > 0.05$).

Table 4: Comparison of the mean hemodynamic parameters between Group A and Group B at the 5-minute mark.

| 5 minute | Group A n=90 Mean ± SD | Group B n=90 Mean ± SD | t values | p values |
|---|---|---|---|---|
| Heart rate (beats/min) | 105.8±5.2 | 90.1±2.1 | 2.27 | 0.029 |
| Systolic BP (mmHg) | 97.3±4.5 | 06.9±3.6 | 2.21 | 0.032 |
| Diastolic BP | 61.3±3.6 | 61.3±3.6 | 2. 21 | 0.032 |
| (mmHg)$SPO_2$ (%) | 98.9±0.3 | 98.8±0.4 | 1.20 | 0.235 |
| MAP (mmHg) | 64.7±4.2 | 74.3±5.3 | 2.55 | 0.016 |

Group A received a 5 IU oxytocin bolus, while Group B received a 5 IU oxytocin IV infusion. The p-value was calculated using an unpaired t-test. The mean differences in all hemodynamic parameters

at the 5-minute mark were statistically significant ($p < 0.05$), except for SPO2, which showed no statistically significant difference ($p > 0.05$).

## 4. Discussion

Oxytocin is produced by posterior pituitary gland, helps reduce blood pressure through the dilation of peripheral vasodilation, raises heart rate, and stimulates the contractions in the uterus.[3] The effect of oxytocin on uterine contractions is amplified uterus has an increase receptors for oxytocin.[4]
In full-term parturient, the sensitivity to oxytocin in women peaks because of an increase in intrauterine receptors for oxytocin driven due to rising levels of estrogen in pregnancy.[7]
As a result, during a typical delivery, the oxytocin released from the posterior pituitary in response to fetal stimulation of the birth canal can induce labor pain and powerful uterine contractions, even at a low dose of 10 IU/min[6]

As changes in hemodynamic are directly related to oxytocin dose administered intravenously, research has been conducted to determine effective concentrations and optimal methods of intravenous injection.[7] Infusing oxytocin at 1 IU/min resulted in similar uterine contractions and blood loss as at a rate of 5 IU/min IV injection, despite the total dose of oxytocin potentially exceeding 5 IU.[8] However, some studies suggest administering oxytocin at a rate of less than 1 IU per minute, as infusing it more than 0.25 IU per minute may lead to symptoms such as hypotension, tachycardia, increased cardiac output, and myocardial ischemia.[9]

Ayesha k et al[10] showed a dose of 5 IU and 10 IU intravenous bolus injection of oxytocin is not considered to be safe. On other hand Rosseland La et al[11] also published the same effects. Begum N et al[12] a dose greater than 5 IU may not be required, as effective uterine contractions were achieved with bolus doses ranging from 0.5 to 3 IU. Our findings were similar to their results as mentioned above showing that hemodynamic changes by oxytocin were temporary. This study indicates that a slower infusion of 5 IU of oxytocin can effectively reduce cardiovascular side effects, while a rapid bolus injection of oxytocin leads to significant cardiovascular instability.

This study revealed in group A, which was administered a rapid bolus of 5 IU of oxytocin, the mean arterial pressure (MAP) dropped by an average of 23 mm Hg, ranging from 19 to 32 mm Hg within 2-5 minutes. In contrast, group B experienced an average MAP decrease of 13 mm Hg, ranging from 9 to 19 mm Hg during the same time period. Additionally, heart rate changes were significantly greater in group A compared to group B within the 2 to 5-minutes.

We recommend that further study will be helpful to evaluate the effects of oxytocin on hemodynamic changes in comparison of 5 IU infusion versus 10 IU infusion in major blood loss parturient. We only studied the effects of 5 IU oxytocin infusion with comparison of 5 IU bolus. Therefore, more study will elaborate the beneficence of 5 IU oxytocin infusion versus 10 IU oxytocin infusion.

## 5. Conclusion

Our findings demonstrating that oxytocin infusion during both elective and emergency cesarean sections significantly minimizes adverse hemodynamic effects. Low infusion of oxytocin is an affordable, a generally well tolerated, accepted choice and safe choice. This method when using routinely, helps preventing significant hemodynamic changes. However, high doses of oxytocin can

lead to life-threatening complications if not managed immediately. Based on our results, the use of oxytocin infusion is recommended and it can be safely and effecively integrated into current clinical practice.

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