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Predetermined Doses of Crystalloid Preload With Crystalloid Coload For Prevention of Hypotension in Parturients Undergoing Caesarean Section Under Subarachnoid Block.

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Abstract: *The issue of hypotension following induction of subarachnoid block remains a long standing major area of clinical research. Several studies have been carried out to find lasting solution to this burden, but results are still not quite rewarding.*

To determine whether predetermined crystalloid coloading will improve maternal haemodynamic control provided by predetermined crystalloid preloading during subarachnoid block for women who undergo caesearean section under subarachnoid block

Two hundred women scheduled for emergency caesearean section under subarachnoid block were recruited for the prospective observational study. All the parturients received 1 litre normal saline within 15 minutes before induction of spinal anaesthesia, then had another 1 litre normal saline infusion within 15 minutes following induction of subarachnoid block. Maternal haemodynamics, total rescue fluid and ephedrine used were documented.

Incidence of hypotension was 5% among patients who had this combination of crystalloid loading. Among the ten patients who had hypotension, five of them were corrected with fluid. The remaining parturients were corrected with 3mg of ephedrine each.

predetermined combination of crystalloid preload in conjunction with predeterminedcoload can be used in the prophylactic method of managing spinal-induced hypotension in women undergoing caesarean section under subarachnoid block.

Keywords: *caesarean section, hypotension, preload, preload-coload, spinal anaesthesia*

I. INTRODUCTION

Dated back to when spinal anaesthesia was first performed by Leonard Corning[1] in 1855 where he accidentally pierced the dura mater of experimenting dog, the world anaesthetists are faced with the herculean task of mitigating hypotension following spinal anaesthesia. Several studies have been carried out in order to look into prevention of hypotension associated with spinal anaesthesia amongst parturients scheduled for caesarean section[1,2,3] Hypotension following spinal anaesthesia for caesarean section remains a common burden, despite different preventive and curative strategies for its management. These strategies include using mechanical method (routine uterine displacement), drug manipulations (prophylactic vasopressors[3,4,5,6]), reduction in spinal dose of local anaesthetic agent plus the use of opioids, fluid loading (preload or coload with crystalloid or colloid). However, none of these strategies has proved satisfactory.

Double tragedy can result when both mother and foetus are faced with severe complications resulting from hypotension following spinal anaesthesia. Severe hypotension can result in not only maternal death but fetal mortality and morbidity[4,5] Several studies have supported the need to preload every patients before induction of spinal anaesthesia.[1,2,3] These studies showed that there was reduction in maternal hypotension by at least 25%.[4,5] Spinal anaesthesia is nowadays considered as the standard anaesthetic technique for most elective and emergency caesasean section, the need to prevent hypotension following its induction is very paramount to world anaesthetists.[2] The incidence of hypotension,which is more than 80% without any prophylactic measures, can be lowered by several ways till today but no single method completely prevents hypotension.[4,5] Over the last few years, there is a trend to rely more on vasopressor than either crystalloid or colloid alone.[4,6,7,8,9]

Benerjee et al[10] concluded that it was unnecessary to delay surgery in order to deliver a preload of fluid and regardless of the fluid strategy; the incidence of maternal hypotension was high[10]. If the incidence of hypotension is still high in each of the coload or preload group, hence it is necessary to evaluate the effect of combination of preload and coload on incidence of hypotension.

The coload plus preload method of preventing hypotension is new. very limited studies have been carried to detect effectiveness of combination of preload and coload in preventing hypotension during spinal anaesthesia. Its effectiveness has been earlier documented by Williamson et al.[11] and Afolayan et al.[12] in different studies. The predetermine method is regularly used by some Nigerian Anaesthethists without appropriate evaluation, hence the need to carry out this observational study.

II. PATIENTS AND METHODS

This was a prospective observational study. The study received Institutional Ethical Committee Research Review approval from Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria. Two hundred parturients of ASA physical status 1 or 2 scheduled for emergency cesarean section under subarachnoid block were enrolled in the study. Exclusion criteria included age under 18 years, height <150cm, weight <65kg, bleeding disorders, chronic hypertension, pregnancy induced hypertension, preeclampsia, eclampsia, known cardiovascular diseases, gestational age less than 36 weeks, packed cell volume of less than 30%, or any contraindication to spinal anaesthesia. Informed consent was received directly from all patients who participated in the study. They were reliably informed that their procedure could be converted to general anesthesia if there was any failed or difficult spinal anesthesia

Two hundred women scheduled for emergency caesearean section under subarachnoid block were recruited for the prospective observational study. All the parturients received 1 litre normal saline within 15 minutes before induction of spinal anaesthesia, then had another 1 litre normal saline infusion within 15 minutes following induction of subarachnoid block. They also had 10ml/kg ringers lactate to run for the next two hours as maintenance. Maternal haemodynamics, total rescue fluid and ephedrine used were documented.

All patients received ranitidine 50mg and 10mg metoclopramide intravenously prior to surgery. For each of the patients, two 16G intravenous cannulae were put in place for the purpose of this study. Following the

application of routine monitoring, non-invasive monitoring was commenced and documented including non-invasive blood pressure (NIBP), oxygen saturation (S_PO_2), pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP). Each patient had a total fluid of 2 litres for both loading excluding maintenance and rescue fluid. Induction of spinal anaesthesia was achieved with patients in sitting position. Their legs were hanging from the edge of the operating table with the support of a stool under their feet. They were asked to bend the neck forward and arch out their back maximally. Under aseptic condition, the spinal needle was introduced into the subarachnoid space. After withdrawing the stylet from the spinal needle, appearance of the free flow of cerebrospinal fluid in the hub of the needle indicated a successful placement. All patients received 2.5ml of 0.5% hyperbaric bupivacaine over 15s intrathecally in the L_{3-4} or L_{2-3} intervertebral space with a 25 G Quincke's spinal needle (Becton Dickson, Franch Lakes, NJ, USA). The patients were immediately put in supine position with a 15^o left lateral tilt using wedge under the right hip. Sensory bock height was assessed using loss of sensation to gentle pin prick test. A sensory block height of T6 was the minimum desired level of block for the commencement of the caesarean section. The following parameters: pulse rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation were recorded every three minute for the first fifteen minutes, every 5 min for the next 15 minutes and every ten minutes thereafter till the end of surgery. Following the delivery of the baby, the mother was given 10 units of oxytocin intravenously, then she had infusion of 40 units of oxytocin in 500 mls normal saline to run for 4 hours.

Maternal hypotension was defined as a decrease in systolic blood pressure to less than 80% of the baseline systolic blood pressure or systolic blood pressure less than 90 mmHg. Hypotension was managed with intravenous fluid as first line of management. Ephedrine in aliquots of 3 or 6mg, was administered whenever there were two consecutive readings of hypotension or hypotension was unresponsive to rapid fluid management. Total amount of rescue ephedrine and fluid administered were documented. Management of hypotension continued until systolic blood pressure recovered to the baseline reading.

Primary outcome measure was the incidence of maternal hypotension in the study population. Additional data including onset of sensory block, side effects such as nausea anad vomiting, bradycardia, back pain, itching and headache were recorded.

III. RESULTS

A total of 200 parturients were studied. All of them completed the study. None of the parturients had their spinal anaesthesia converted to general anaesthesia. We did not encounter difficulty in instituting induction of spinal anaesthesia.

Demographic, obstetric and intraoperative clinical variables were documented among the study participants as shown in Tables 1 and 2. Most of them were unbooked. They were mostly young adult and multiparous.

As shown in Table 2, duration of crystalloid preloading and coloading ranged from 8 to 15 minutes and 8 to 13 minutes respectively. A good block height was attained for all the patients, with median and range of T4(T4-T5).. Median and range for the duration of surgery was 60(60-111). Duration of anaesthesia ranged between 83 and 162 minutes. The time taken to conduct induction of anaesthesia ranged from 3 minutes to 11 minutes, APGAR Score in one minute and ten minutes were 7(7-10) and 10(8-10) respectively

. Incidence of hypotension was five percent among thsese patients who had both loading. Two and half percent of the population had rescue administration of crystalloid without the use of ephedrine. Only 2.5% of the study population had rescue ephedrine given according to table 3. The total fliud administered was 2.3 ±0.8 litres. There was intraoperative incidence of shivering in 4 patients. This was treated with intravenous tramadol.

IV. Discussion

According to this present study, it is discovered that predetermined combination of crystalloid preload in conjunction with predetermined crystalloid coload is capable of reducing maternal hypotension in women

undergoing caesarean section under subarachnoid block. This study is designed to popularize the helpful effect of combining crystalloid preload and crystalloid coload in reducing the incidence of haemodynamic shift amongst women scheduled for caesarean deliveries. Majority of the parturients who were study did not experience hypotension following subarachnoid block. This finding is in support of the findings of Afolayan et al[12] which stated that the incidence of hypotension was significantly high among patients in preload group and coload group compared to combined preload-coload group.

Banerjee et al [10] found that hypotension following spinal anaesthesia, when preload is used alone for caesarean section, was common and sometimes might be life threatening. Banerjee et al observed that incidence of hypotension in the preload group was 156/250 (62.4%) and comparable to 159/268 (59.3%) in the coload group. They recommended that it was unnecessary to delay surgery in order to deliver a preload or coload of fluid. Therefore, with the high incidence of hypotension when crystalloid preload is used alone or when crystalloid coload is used alone, it is therefore reasonable to research whether the addition of predetermined dose of crystalloid preload plus crystalloid coload could militate the incidence of hypotension following spinal anaesthesia. Banerjee at al[10] were of the opinion that, regardless of the fluid loading strategies, incidence of maternal hypotension was still high. Whether preload is used alone or colad is administered alone, the incidence of hypotension is still high according to the findings in their study. Several study had proved that volume preload or coload is not effective in preventing spinal-induced hypotension in the obstetric population.[12,13,14,15]

Dyer et al [16], they were of the opinion that the current methods of crystalloid preload administration prior to spinal anaesthesia for elective caesarean section are relatively ineffective in preventing hypotension. In order to examine the relevance of the timing of the fluid administered, fifty women were randomized to receive 20 ml/kg of crystalloid solution within 20 minutes prior to induction of spinal anaesthesia (preload) or an equivalent volume by rapid infusion immediately after spinal anaesthesia (coload). They discovered that maternal hypotension was still on the high side among parturients in each of the groups. Maternal hypotension was high in the findings of Dyer et al[16] because it has been documented that preload or coload alone was not sufficient enough to prevent incidence of hypotension during spinal anaesthesia for caesarean delivery.[12,13,14] hence the need to find alternative approach to the management of hypotension following spinal anaesthesia. Since many authors have demonstrated that preload alone or coload alone is not effective in preventing hypotension following subarachnoid block, hence the need to combine the two predetermined volume of preload and coload for effective management of haemodynamic shift following subarachnoid block.

It has been discovered that preload regimen alone cannot compensate enough for reduction in arterial blood pressure after spinal anaesthesia. This was corroborated by works of Tamilselvan et al.[17] Having hypothesized that colloid solutions, compared with crystalloid, would produce the largest increase in cardiac output and have the lowest incidence of hypotension, Tamilselvan et al [17] randomized patients to receive 1 of 3 fluid preload regimens given over 15 minutes: 1.5 L crystalloid (Hartman's solution), 0.5 L of 6% hydroxyethyl starch or 1 L of 6% hydroxyethyl starch solution. They found that the incidence of hypotension was 70%, 35% and 65% for groups with Hartman's solution, 0.5HES and 1LHES respectively. According to the report of Tamilselvan et al,[17] the incidence of hypotenson (70%) in preload group with 1.5 L Hartman's solution was higher.[18] many authors have condemned the use of preload or coload alone.[16,17,18,19] From our observational study, the incidence of hypotension is laid to rest using the combination of the two method of crystalloid loading.

In their attempt to eliminate the persistent doubt about comparative advantages of any of the crystalloid fluid loading, Bouchnak et al [19] reported a record higher incidence of hypotension in the coload group (96.6%) than in the preload group while comparing 20 ml/kg of crystalloid given over 15 minutes as coload or preload in the obstetric population. They could not find any advantage in the two different approaches used to reduce incidence of hypotension. They recommended the need to search for a more potent means of preventing maternal hypotension. Our study has discovered a more potent means of preventing maternal hypotension. This is evidence in our study, using combined method, the percentage of hypotension is 5%. Worried by incessant incidence of hypotension whether preload or coload using cystalloid or colloid, some researchers further

evaluated different pharmacological means in combinations with either crystalloid coload, colloid preload, colloid coload or crystalloid preload, but all to no avail.[2,3,4,6,7]

In support of the notion behind this present study, that combination method is better than a single method, Mercier et al [9] stressed the advantages of combination therapy in the management of hypotension during spinal anaesthesia for caesarean section. After analyzing different preventive and curative strategies for the management of hypotension among trials published in English or French using Medline data base, they concluded that crystalloid loading at the time of spinal injection (coload) enhanced the haemodynamic control provided by prophylactic vasopressors.[20] They affirmed that combination methods of interventions in the management of hypotension reduced the incidence of hypotension compared with using each method on its own.[21] Our study utilize the principle of combination therapy in the management of maternal hypotension following subarachnoid block.

In a survey of the management of spinal-induced hypotension for scheduled caesarean delivery, Allen and co-workers [22] found that 35% of the anaesthesiologists in academic practice were less likely to use fluid preloading only and 42% were more likely to use fluid preloading or coloading in addition to prophylactic vasopressors.[22] Similar to our study, the reports of Mercier et al [9] and Allen et al [22] further underscore the need for combination methods of interventions in the management of hypotension during spinal anaesthesia. However, it is worthy of note that prophylactic vasopressor, especially ephedrine, causes an increseased incidence of fetal acidosis and worsens acidosis in feotus with compromise or distress. Therefore combination of fluid loading will be beneficial to the foetus.

Similar to our study, half dose crystalloid preload and half dose crystalloid coload combination strategy, Williamson et al [11] observed that Spinal-induced hypotension remained the most common complication associated with spinal anaesthesia for caesarean section. Having evaluated the recent evidence that a 20-mL/kg bolus via pressurized infusion system administered at the time of subarachnoid block (coload) might provide better prophylaxis than the traditional administration of a 20-mL/kg crystalloid infusion (preload) approximately 20 minutes before subarachnoid block; they hypothesized that there was benefit in administering half of the fluid bolus (10 mL/kg) before and half immediately following induction of spinal anaesthesia. Eighty-seven subjects were enrolled in this prospective, randomized investigation, 43 preload group (control) and 44 preload plus coload group (experimental).

Analysis of the percentage of subjects in each group requiring supplement boluses revealed that 31/43 (72%) in the preload group required supplementation compared to 17/44 (39%) subjects in the experimental group.[11] Supplemental vasopressors required to treat maternal hypotension in the preload group were not statistically significant. Total intravenous fluid and supplemental bolus requirements were significantly higher in the preload group. Hypotension was treated as it occurred. They recommended replacing standardized prophylactic crystalloid fluid administration with the preload/coload combination method described therein. According to our study, the incidence of hypotension (5%) in the combined preload-coload study was lower than the incidence of hypotension (39%) in the combined preload-coload group that Williamson et al[11] reported. The difference was probably due to very low dose of crystalloid preload and low dose of crystalloid coload in their combination method. They also used a very low dose of maintenance fluid (100 ml/hr) as documented by Williamson et al.[11]

V. CONCLUSION

Combined predetermined volume of crystalloid preload and coload can be used for prophylactic method of managing spinal-induced hypotension in women undergoing caesarean section under subarachnoid block. One litre of rapid crystalloid loading at the time of spinal injection (coload) enhances the haemodynamic control provided by crystalloid loading before spinal injection (preload). This has subsequently reduce incidence of hypotension to five percent.

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Table 1: Demographic and obstetric data

Parameter	**Values**
Age (yr)	30.0 ± 7.5
Height (cm)	158.2 ± 5.5
Weight (kg)	67.9 ± 23.0
Prenatal status	
Booked	86
Unbooked	114
Gestational age(wks)	38± 0.7
Parity	
Nulliparous	84
Multiparous	116

Table 2: intra-operative clinical variables

Parameter	**Group CL Median (Range) (n=200)**
Duration of fluid preloading (min)	11(8-15)
Duration of fluid coloading	10(8-13)
Block height (seg)	T4(T4-T5)
Induction – delivery (min)	23(17-43)
Duration of anaesth (min)	95(83-162)
Duration of surgery (min)	60(40-111)
Duration of induction of Anaesth	5(3-11)
Apgar score (1min)	7(7-10)
Apgar score (5min)	10(9-10)

Table 3: Fluid management and incidence of hypotension

Parameter	**values**	**percentages**	
Incidence of hypotension (n)	10	5	
Patients with rescue fluid (n)	**5**	**2.5**	
Patients with rescue ephedrine (n)	**5**	**2.5**	
Total fluid administered (litres)	**2.3±0.8**		
Shivering (n)	**4**	**2**	**-**