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Original Article

Shock Index and Modified Shock Index Might be Reliable for Predicting Morbitidy in Pregnancy-Related Hypertensive Disorders

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ABSTRACT

Objective: Maternal Early Warning Criteria including; systolic - diastolic blood pressure, peripheral oxygen saturation and urine output, is a useful marker for predicting postoperative complications. Shock index and the modified shock index were used to determine the need for fluid and transfusion in hypovolemia. The aim of this study is to evaluate the effectiveness of using shock index and modified shock index as a parameter of the early warning system to predict the need for postpartum blood transfusion, complications and mortality in pregnancy-related hypertensive diseases.

Methods: Following the Ethics Committee approval, between 2012-2017, 192 patients between the ages of 13-47, undergoing caesarean section due to preeclampsia, eclampsia, chronic hypertension and gestational hypertension were enrolled in this study.

Results: There was a positive correlation between SI and embolism and arrhythmia at admission and between the modified shock index and Intrauterine Growth Retardation at delivery ($p<0.05$). There is a significant positive correlation between the shock index and modified shock index at admission and fresh frozen plasma and Platelet suspension transfusion. There is a significant positive correlation between the shock index at delivery and packed red blood cells, fresh frozen plasma, and platelet suspension transfusion. There is a significant positive correlation between the modified shock index at delivery fresh frozen plasma and packed red blood cells transfusions ($p<0.05$).

Conclusion: It was concluded that modified shock index and shock index could important markers in predicting maternal and fetal complications in hypertensive diseases due to pregnancy as well as postpartum blood transfusion.

INTRODUCTION

According to the current data published by the World Health Organization (WHO), hypertensive disorders, maternal hemorrhage, and sepsis account for 50% of maternal deaths related to pregnancy.[1] In pregnancy-related hypertensive disorders, there is an increase in the incidence of thromboembolic complications and postpartum hemorrhage in the postoperative period.[2] Therefore, early clinical identification and treatment of conditions such as pregnancy-related hypertensive disorders and postpartum hemorrhage are critical for maternal outcome.

Preeclampsia, a pregnancy-related hypertensive disorder, is diagnosed in 3-5% of pregnancies.[3] Decreased placental perfusion, decreased organ perfusion, and endothelial dysfunction play a role in the development of preeclampsia and cause damage to multiple organs. Infarction, necrosis, and intraparenchymal hemorrhage are observed in the liver and adrenal glands secondary to decreased perfusion. Hypovolemic shock occurs resulting from endocardial necrosis in the heart. While glomerular endotheliosis occurs in the kidney, occlusion occurs in the capillary lumen. Preeclampsia causes various maternal and fetal complications due to poor placental perfusion and vasospasm. The incidence of intrauterine growth retardation (IUGR) elevates among the babies of mothers with preeclampsia, which is responsible for 15% of preterm labors. Insufficiency of prenatal care for preeclamptic patients leads to approximately 5000 maternal deaths annually.[4] Advanced age, obesity, and the presence of multiparity, pulmonary edema, acute renal failure, and coagulopathy worsen the course of the disease.[5] In cases of preeclampsia accompanied by pregnancy-related hypercoagulopathy, individuals become more susceptible to pulmonary embolism and other embolic complications due to endothelial dysfunction.[6]

Conventional methods such as blood pressure, heart rate, and urine output are frequently used to predict hemodynamic complications such as hemorrhage, shock, and sepsis in the postpartum period.[7,8] In recent years, the shock index (SI) parameter, which is the ratio of heart rate to blood pressure, has started to appear in studies as a new method for hemodynamic monitoring. The normal range of SI has been indicated to vary from 0.5 to 0.7 in healthy individuals. An increased SI value despite normal heart rate and normal systolic blood pressure (SBP) has been associated with the fall of the pressure in the left ventricle.[9] It has been demonstrated that mortality increases if SI is above 1 in patients presenting to the emergency department (ED).[10] Some studies have indicated that SI may be superior to conventional monitoring methods in the early prediction of complications such as hemodynamic insufficiency and associated massive blood transfusion and hysterectomy.[11] It has been shown in studies conducted in pregnant women that the risk of developing postpartum hemorrhage is high and maternal mortality increases in patients with an SI value above 0.9.[12,13]

The modified shock index (MSI) was introduced by Liu et al.[14] in 2012 as the ratio of heart rate and mean arterial pressure, and the normal range was specified as 0.7-1.3. In several studies, MSI has been indicated to be effective in the prediction of blood transfusion need for trauma patients.[15] Liu et al. indicated that an MSI of >1.3 is associated with a higher incidence of hemodynamic insufficiency, mortality in patients applying to ED, and a greater rate of intensive care unit (ICU) admissions.[14] Another study reported that when the MSI cut off value was determined as 1.15 in trauma patients admitted to ED, MSI values above this value were associated with an increase in the need for massive transfusion.[15]

Despite all these studies, there is not enough data regarding the use of maternal SI and MSI in the prediction of maternal and fetal outcomes and the need for transfusion of blood and blood products in the postpartum period. The aim of the present study is to investigate the impact of SI and MSI on feto-maternal morbidity and mortality and to determine a cut off value in the preeclampsia group.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted following the Ethics Committee approval (protocol number: 09.2018.163, date: 06/01/2018). We analyzed the data of 192 patients undergoing a caesarean section after being admitted due to preeclampsia, eclampsia, chronic hypertension (ChHT), and gestational hypertension (GHT) between 2012 and 2017 at our university hospital. We recorded vital signs, demographic characteristics, and postoperative complications for each patient. The data including age, body mass index (BMI), gestational age, duration of hospital stay, laboratory results (ALT, AST, BUN, creatinine, Hb, Hct, INR, Plt, albumin), fetal weight at birth, and APGAR scores at the 1st and 5th minutes were recorded.

We evaluated pulse rate, systolic and diastolic blood pressure (DBP), SI, and MSI both on admission and during labor, and investigated the association of SI and MSI on admission with IUGR, pulmonary embolism, seizure, and development of postoperative severe arrhythmia. The heart rate and blood pressure values were recorded every 5 minutes during the surgery. The type of anesthesia was determined according to the staff anesthesiologist's decision after the preanesthesia assessment. Either spinal anesthesia or general anesthesia was given. Spinal anesthesia was performed using a pencil point 25G spinal needle at the L4-5 or L3-4 level in a sitting position. General anesthesia patients were administered IV propofol 2-3 mg/kg, fentanyl 1-2 mcg/kg, and rocuronium 0.6 mg/kg during induction and sevoflurane 2% with a 50% oxygen and 50% air mixture as maintenance of anesthesia.

The need for blood transfusion was recorded. Red blood cell transfusion was given if the patient's Hb level was below 9 g/dL. FFP was given when there was oozing and the INR level was higher than 1.5. A platelet transfusion was administered if the platelet count was below 100,000/µL.

Statistical Analysis

While evaluating the data obtained from the study, we used IBM SPSS Statistics 22 for statistical analyses. The One-Way ANOVA test was used for normally distributed quantitative data, and the Kruskal Wallis H test was used for non-normally distributed quantitative data. While the Mann Whitney U test was used for the comparison of non-normally distributed data between two groups, the Chi-square test was used to examine discrete variables. The results were evaluated in a 95% confidence interval and with a significance level of $p<0.05$.

RESULTS

The study included 140 patients with preeclampsia, 15 patients with eclampsia, 24 patients with ChHT, and 13 patients with GHT. The patients were aged from 13 to 47 years (31.93±6.54 years). We observed a statistically significant difference regarding the values of average age and gestational age ($p<0.05$). Hospital stays and BMI values were statistically similar between the groups. There was statistically significant similarity between the groups except for creatinine, albumin, and INR levels ($p>0.05$) (Table 1).

No statistically significant difference was observed between the groups regarding birth weight and APGAR scores (Table 2).

It was observed that postpartum pulse rate, SI, and MSI measurements were statistically significantly higher than the measurements on admission to the hospital ($p<0.05$). However, no statistically significant difference was observed regarding blood pressure measurements (Table 3).

The pulse rate, systolic blood pressure, diastolic blood pressure, SI, and MSI values at the time of admission to the hospital were found to be statistically significantly similar to the pulse rate, systolic blood pressure, diastolic blood pressure, and MSI values measured after labor. The shock index after birth was found to be statistically significantly higher in the eclampsia and GHT group compared to the other groups ($p<0.05$) (Table 4).

It was determined that there was a positive, significant correlation between SI on admission and embolism and arrhythmia while there is a positive, significant correlation between SI during labor and seizures. Moreover, a positive, significant correlation was found between MSI during labor and creatinine levels, IUGR, and seizures ($p<0.05$) (Table 5).

Table 1. Demographic data

	Preeclampsia (n=140)	Eclampsia (n=15)	ChHT (n=24)	GHT (n=13)	p
Age (years)	31.36±6.33	27.20±7.28	36.63±4.12	34.92±6.06	0.001*[b]
BMI (kg/m2)	31.22±4.85 (30.38)	31.99±8.21 (30.49)	33.34±5.90 (31.6)	32.25±2.93 (32.8)	0.196[m]
Gestational Age (weeks)	36+3	35±3	33±3	37±2	0.015*[m]
Hospital stay (day)	4.7±2.4(4)	4.4±0.9(5)	6.75±5.83(5)	3.62±1.33(3)	0.205[m]
BUN (mg/dL)	10.86±3.92(10)	11.73±6.06(10)	10.5±40.7(10.5)	9.38±4.81(9)	0.348[m]
ALT (IU)	52.8±120.8(16)	54.8±79.1(20)	16.1±8.1(14)	56±111.2(11)	0.269[m]
AST (IU)	84.24±305.1(22.5)	102.3±174.8(27)	23.3±8.1(21)	79.2±147.1(20)	0.057[m]
Hb (g/dL)	12.42±8.38(11.8)	11.92±1.95(12.5)	11.49±1.34(11.7)	11.91±2.13(11.6)	0.787[m]
Htc (%)	34.56±4.73	36.1±4.96	34.49±3.35	35.69±5.83	0.559[b]
Creatinine (mg/dL)	0.65±0.24(0.6)	0.76±0.23(0.78)	0.63±0.15(0.6)	0.52±0.14(0.49)	0.018[m]
INR	0.97±0.95(0.96)	1.05±0.13(1)	0.98±0.07(0.98)	0.91±0.31(1.02)	0.010*[m]
Albumin (g/dL)	2.82±0.48(2.9)	2.59±0.43(2.6)	2.94±0.39(3.04)	3.05±0.39(3.1)	0.030*[m]
PLT (x10^9/L)	195.69±81.87	165.87±73.38	205.46±53.78	192.77±73.42	0.469[b]

[b]One-Way ANOVA test: values are given as mean±standard deviation; [m]Kruskal-Wallis H test: values are given as mean±standard deviation (median+Iqr); *p<0.05: statistically significant difference. ChHT: chronic hypertension; GHT: gestational hypertension; BMI: body mass index; kg: kilogram; mg: miligram; dL: deciliter. ALT: alanine transaminase; AST: aspartate transaminase; IU: international unit; g: gram; Hb: hemoglobin; Htc: hematocrite; INR: international normalized ratio; PLT: platelet; L: liter.

Table 2. Effects of pregnancy-related hypertensive disorders on the newborn

	Preeclampsia (n=140)	Eclampsia (n=15)	ChHT (n=24)	GHT (n=13)	p
Birth weight (g)	1985±888	1961±879	2116±850	2551±750	0.156[b]
APGAR (1st min;5th min)	8;9	7;9	7.5;9	9;10	0.212[m]

[b]One-Way ANOVA test: values are given as mean±standard deviation; [m]Kruskal-Wallis H test: values are given as mean±standard deviation (median+Iqr); *p<0.05: statistically significant difference; ChHT: chronic hypertension; GHT: gestational hypertension; g: gram; min: minute.

Table 3. Haemodynamic data recorded on admission and during labour

	Admission (n=192)	Labour (n=192)	p
Pulse rate	94.06±14.21(95)	104.59±18.38(102)	0.001*[a]
SBP	167.53±20.19(168)	167.2±22.61(170)	0.878[a]
DBP	100.39±14.87(100)	102.04±16.74(100)	0.276[a]
SI	0.57±0.12(0.6)	0.63±0.14(0.6)	0.001*[a]
MSI	0.78±0.16(0.8)	0.86±0.18(0.8)	0.001*[a]

[a]Mann Whitney U test: values are given as mean±standard deviation (median); *p<0.05: statistically significant difference. n: number; SBP: systolic blood pressure; DBP: diastolic blood pressure; SI: shock index; MSI: modified shock index.

Table 4. Distribution of haemodynamic data at admission and during labour among the different clinical manifestations of the disorder

	Preeclampsia (n=140)	Eclampsia (n=15)	ChHT (n=24)	GHT (n=13)	p
Pulse rate on admission	94.4±13.7(95)	87.3±14.5(92)	95.5±16.3(93.5)	95.5±14.3(98)	0.409^{m}
SBP on admission	166.6±19.6(167)	160.9±23.4(160)	177.5±21.7(175)	166.5±14.9(170)	0.061^{m}
DBP on admission	100.7±14.9(100)	100.8±17.7(105)	99.1±13.6(100)	98.5±15.4(100)	0.823^{m}
SI on admission	0.58±0.12(0.6)	0.56±0.11(0.6)	0.55±0.11(0.5)	0.58±0.12(0.6)	0.527^{m}
MSI on admission	0.78±0.16(0.8)	0.75±0.16(0.8)	0.76±0.11(0.75)	0.8±0.16(0.8)	0.885^{m}
Pulse rate during birth	103.6±18.2(100)	116.9±21.4(110)	100.8±16.4(100)	107.7±16.6(105)	0.088^{m}
SBP during birth	167.6±22.9(170)	161.1±23.8(162)	171.2±22.7(174)	162.6±18.4(165)	0.508^{m}
DBP during birth	102.3±16.9(100)	101±17.5(100)	103.7±16(100)	97.5±15.7(100)	0.838^{m}
SI during labour	0.62±0.13(0.6)	0.74±0.18(0.7)	0.6±0.09(0.6)	0.68±0.14(0.7)	0.042*^{m}
MSI during labour	0.85±0.18(0.8)	0.95±0.21(0.9)	0.81±0.12(0.8)	0.89±0.18(0.9)	0.147^{m}

^{m}Kruskal-Wallis H test: values are given as mean±standard deviation (median+Iqr). *p<0.05: statistically significant difference. ChHT: chronic hypertension; GHT: gestational hypertension; n: number; SBP: systolic blood pressure; DBP: diastolic blood pressure; SI: shock index; MSI: modified shock index.

Table 5. Correlation of SI and MSI on admission and during labour with patient outcome(s)

	Creatinine	IUGR	Pulmonary embolism	Seizure	Postoperative serious arrhythmia
SI on admission	0.802	0.913	0.010	0.617	0.035
MSI on admission	0.653	0.658	0.066	0.245	0.092
SI during labour	0.395	0.169	0.654	0.002	0.543
MSI during labour	0.049	0.045	0.829	0.007	0.960

P<0.05: statistically significant difference. IUGR: intrauterine growth retardation; SI: shock index; MSI: modified shock index.

Table 6. The correlation between SI, MSI and transfusion of blood products and maternal and fetal outcomes

	RBC	FFP	Platelets	Birth weight	APGAR	Hospital stay
SI on admission	0.771	<0.001	<0.001	0.870	0.676	0.385
MSI on admission	0.982	<0.001	<0.001	0.495	0.579	0.528
SI during labour	0.013	0.005	0.040	0.205	0.406	0.344
MSI during labour	0.004	0.004	0.065	0.691	0.836	0.315

P<0.05: statistically significant difference. RBC: packed red blood cells; FFP: fresh frosen plasma; APGAR: appearance pulse grimace activity respiration; SI: shock index; MSI: modified shock index.

No statistically significant difference was detected between the groups regarding the use of blood products (p>0.05).

There is a positive, significant correlation between SI and MSI on admission and transfusion of fresh frozen plasma (FFP) and platelet suspension. There is a positive, significant correlation between SI and MSI during labor and transfusion of packed red blood cells (RBC), FFP, and platelet suspension. Moreover, MSI during labor was found to have a positive, significant correlation with the transfusion of FFP and platelet suspension (p<0.05). On the other hand, no significant correlation was detected between the SI and MSI scores and hospital stay, APGAR score, and birth weight (Table 6).

No correlation was observed between the use of blood product(s) and systolic and diastolic blood pressures (p>0.05).

As a result of the regression analysis, the model for estimating the RBC, FFP, and platelet values of the shock index result used during the application was 80.2% successful. Similarly, the model for estimating the RBC, FFP, and platelet values of the modified shock index result used during the application was 73.4% successful. It was observed that the model for estimating the RBC, FFP, and platelet values of the shock index result used during delivery was 69.8% successful, and the model for estimating the RBC, FFP, and platelet values of the modified shock index result used during delivery was 71.9% successful.

DISCUSSION

This study aimed to reveal the predictive value of maternal SI and MSI in the prediction of maternal and fetal outcomes and the need for transfusion of blood and blood products after giving birth. When the patients' values at admission were compared with the values at birth, no difference was found in systolic and diastolic blood pressure values, which are routine follow-up parameters, while a significant increase was found in pulse rate, SI, and MSI values. Moreover, there was a significant relation between admission SI and postoperative embolism and arrhythmia, and between MSI during labor and creatinine and IUGR. The increase in admission and labor SI and MSI values were found to be associated with the transfusion of FFP and platelets, and the increase in SI and MSI during labor were associated with the transfusion of FFP, RBC, and platelets, and the increase in labor SI was associated with elevated platelet transfusion.

There are studies in the literature demonstrating that increased SI and MSI values are effective in the prediction of massive blood transfusion in addition to standard hemodynamic monitoring methods for ensuring early prediction of postpartum hemorrhage. Nathan et al.[16] found the increased SI value to be associated with massive blood transfusion after postpartum hemorrhage. Additionally, Le Bas et al.[17] determined that a SI score of >1.1 at the 10th and 30th minutes after giving birth were effective in predicting hemorrhage and blood transfusion. However, Le Bas et al.[17] did not indicate a significantly increased level in patients with preeclampsia. In this study, we found that increased MSI and SI values recorded on admission to the hospital and during labor in the patient group with the pregnancy-related hypertensive disorder were correlated with the increase in FFP and RBC transfusion. On the other hand, it was also demonstrated that SI on admission and during labor was associated with the transfusion of platelet suspension, and thus, SI was superior to MSI in this regard.

Nevertheless, Borovac-Pinheiro et al.[13] found a positive correlation between the elevated SI value measured during and after labor in patients undergoing vaginal delivery and increased need for blood transfusion, but they did not observe a significant correlation in patients with cesarean section. We, on the other hand, observed that besides increased SI during labor, increased SI at admission was also related to greater transfusion need. Additionally, we observed that elevated SI was indicative of elevated need for blood transfusion in cesarean section patients, as well.

There are studies in the literature demonstrating the predictive value of blood pressure on maternal mortality and morbidity in pregnant women with preeclampsia.[18] However, we did not find a difference between the admission and labor SBP and DBP values of the patients, and moreover, the SI, MSI, and pulse rate on admission were statistically significantly higher than those during labor. These results gave rise to thought that the SI and MSI values of the patients at the time of labor may be more valuable in the prediction of the clinical course of the disease in pregnancy-related hypertensive disorders. Again, in the literature, there are studies indicating that postpartum hemorrhage and blood transfusion are associated with systolic blood pressure.[16] However, in our study, neither systolic nor diastolic blood pressure was found to be correlated with postoperative transfusion. Considering these results, we think that blood pressure measurement cannot be a sufficient predictor for postpartum hemorrhage and need for transfusion in patients who already have pregnancy-related hypertensive disorders, and that although a specific cutoff value could not be determined as in our results, SI and MSI may be effective in predicting postoperative transfusion need in the early period.

There are also studies reporting an association between SI and increased ICU admission and need for reoperation.[16] However, we did not identify a difference regarding the length of hospital stay. We are of the opinion that it may be due to the fact that our sample group was composed of patients with pregnancy-related hypertensive disorders who were followed up at our clinic and underwent caesarean section. Although there was not a statistically significant difference between the groups, the hospital stay in the GHT group was shorter compared to the other groups. This may be due to the fact that the clinical course of GHT is milder compared to other forms of pregnancy-related hypertensive disorder.

There is an increased risk for preterm labor in pregnancy-related hypertensive disorders.[19] It was observed in our study that preterm delivery was statistically significantly higher only in the gestational hypertension group. As in our study, Barton et al.[20] also observed that the risk of preterm labor increased in women with gestational hypertension. There was not a statistically significant difference between the groups regarding birth weight and APGAR scores. However, the majority of studies in the literature reported that the higher the severity of a hypertensive disease is, the higher the risk for preterm birth and small for gestational age (SGA) become.[21] This was associated with the small sample group in our study. However, Sheen et al.[22] examined women with pregnancy-related hypertensive disorders in 2019 and found that eclampsia was seen in the younger patient group. These results are similar to our results and suggest that our sample selection is correct independent of the number of patients included. Also, the fact that the groups did not differ significantly in terms of BMI shows that the patients included in the study may represent a homogeneous group.

Gouda et al.[23] found that increased MSI and SI were positively correlated with fatal arrhythmias in patients with STEMI. We also demonstrated that an admission SI >0.9 was positively correlated with postoperative arrhythmia. As the majority of previous studies reported the MSI >1.3 as a critical level, we accepted 1.3 as the critical MSI value in our study while investigating maternal and fetal complications.[14] However, we did not observe a similar correlation when admission MSI was over 1.3. We thought that it might be due to the differences between patient groups in our study and other studies. We, therefore, believe that there is a need for further studies investigating the correlation with arrhythmia in patient groups with pregnancy-related hypertensive disorders.

Keller et al.[24] found in their study that an SI >0.89 was strongly associated with mortality in cases with pulmonary embolism. In the present study, we observed that the rate of pulmonary embolism was higher among the patients with pregnancy-related hypertensive disorders who had increased SI at admission. Although it has not been indicated in previous studies, we thought that during labor, an SI value >0.7, the upper limit in patients with eclampsia, may have a predictive value regarding seizure development.

The major limitation of our study is that it was designed as a retrospective analysis. Also, the failure to perform a more detailed outcome analysis due to insufficient follow-up data in the postoperative period is another important limitation. It is another important point to note that there are studies showing that there is an increased risk of postpartum hemorrhage and maternal mortality when the SI is above 0.9 in pregnant women, and the normal range of the SI has not been determined in the pregnant patient group, yet.[5,12,13] The SI levels were found to be lower in cases of preeclampsia, eclampsia, and GHT. However, there is a need for further studies addressing this issue.[1]

In several studies, MSI and SI were evaluated together as a part of hemodynamic monitoring. There are also studies indicating that the SI value is higher in healthy individuals presenting to the emergency department compared to hypertensive individuals. However, there are not any studies in the literature investigating SI and MSI in pregnant patients with hypertensive disorders. This is the unique characteristic of our study. It is clear that more studies are needed in this area to reduce maternal and fetal mortality by optimizing patient safety.

Conclusions

We concluded that MSI and SI have a significant predictive value not only in the prediction of maternal and fetal complications but also in predicting the need for postpartum blood transfusion for pregnancy-related hypertensive disorders.

Ethics Committee Approval

This study approved by the Marmara University Faculty of Medicine Ethics Committee (Date: 02.02.2018, Decision No: 09.2018.163).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Concept: A.S., U.Z.; Design: A.S., S.S.; Supervision: A.S.; Fundings: K.C.Y.; Materials: K.C.Y., U.Z.; Data: K.C.Y., U.Z.; Analysis: S.S., G.C.; Literature search: K.C.Y., G.C.; Writing: K.C.Y., U.Z., G.C.; Critical revision: A.S.

Conflict of Interest

None declared.

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Şok İndeks ve Modifiye Şok İndeksi, Gebeliğe Bağlı Hipertansif Bozukluklarda Morbiditeyi Tahmin Etmede Güvenilir Olabilir

Amaç: Maternal erken uyarı kriterleri sistolik – diyastolik kan basıncı (SKB/DKB), periferik oksijen satürasyonu ile idrar çıkışını içeren ve postoperatif komplikasyonların öngörülmesinde yararlı bir belirteçtir. Şok indeks (SI) ve Modifiye Şok indeks (MSI) ise hipovolemide sıvı ve transfüzyon ihtiyacının belirlenmesinde kullanılmaktadır. Bu çalışmada, gebeliğe bağlı gelişen hipertansif hastalıklarda postpartum kan transfüzyonu ihtiyacı, anne ve fetüste gelişebilecek komplikasyonların ve mortalitenin ön görüsü için erken uyarı sisteminin bir parametresi olarak SI ve / veya MSI kullanımı etkinliğinin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: Çalışmaya yerel Etik Kurul onayı alındıktan sonra, 2012-2017 tarih aralığında preeklampsi, eklampsi, kronik hipertansiyon ve gebelik hipertansiyonu nedeniyle sezaryen operasyonu geçiren 13-47 yaş aralığında 192 hasta çalışmaya dahil edildi.

Bulgular: Hastaların SI ile başvuru sırasındaki emboli ve aritmi arasında ve doğum sırasında MSI ile İntrauterin Büyüme Geriliği arasında pozitif korelasyon vardı ($p<0.05$). Başvuru sırasındaki SI ve MSI ile taze donmuş plazma ve Trombosit süspansiyonu transfüzyonu arasında anlamlı pozitif korelasyon bulunmaktadır. Doğum sırasındaki SI ile paketlenmiş kırmızı kan hücreleri, taze dondurulmuş plazma ve trombosit süspansiyonu transfüzyonu arasında anlamlı bir pozitif korelasyon vardır. Taze donmuş plazma teslimi ile paketlenmiş kırmızı kan hücresi transfüzyonları sırasındaki MSI arasında anlamlı pozitif korelasyon vardır ($p<0.05$).

Sonuç: Modifiye şok indeksi ve şok indeksinin gebelik ve postpartum kan transfüzyonuna bağlı hipertansif hastalıklarda maternal ve fetal komplikasyonları öngörmede önemli belirteçler olabileceği sonucuna varılmıştır.

Anahtar Sözcükler: Modifiye şok indeks; mortalite; preeklampsi; şok indeks.