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The study of role of shock index in postpartum haemorrhage

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Abstract

Objective: To compare the predictive value of the shock index (SI) with conventional vital signs in postpartum haemorrhage and to calculate the relationship of shock index with adverse maternal outcome in post partum haemorrhage

Methods: The study was a hospital based analytical type of observational study conducted in Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur from March ' 2015 to March ' 2016. All full term normal delivered patients with blood loss>500 ml were taken as (cases). They are selected according to inclusion criteria. Patients were evaluated after informed consent and detailed history was taken and examination done. Vitals were recorded immediately following recognition of PPH. Shock index (SI), mean arterial pressure (MAP) and pulse pressure (PP) were calculated. Adverse clinical outcomes were evaluated which included admission to a intensive care unit (ICU), need for blood transfusion≥2 unit, haemoglobin level <7 gm/dl and surgical interventions to staunch bleeding.

Results: Shock index has the highest AUROC to predict surgical intervention (0.84 for SI [95% CI 0.74–0.95] followed by 0.84 [95% CI 0.74–0.94] for ICU admission). SI compared favourably for other outcomes: SI ≥0.9 had 96.20% sensitivity and 56.20% specificity, and SI ≥1.7 had 26.90% sensitivity and 100.0% specificity for predicting ICU admission.

Conclusions: Shock index compared favourably with conventional vital signs in predicting ICU admission and other outcomes in PPH, even after adjusting for confounding; SI <0.9 provides reassurance, whereas SI ≥1.7 indicates a need for urgent attention. In low-resource settings this simple parameter could improve outcomes.

Keywords: PPH, SI, ICU

Introduction

Approximately 6% of deliveries are complicated by obstetric haemorrhage. (1) Globally PPH is a leading cause of maternal deaths worldwide with an estimated mortality of 1,40,000 per year, 99% of which occur in low and middle-income countries. (LMICs) (2,3)

In the 2003–2005 report of the UK Confidential Enquiries into Maternal Deaths, haemorrhage was the third highest direct cause of maternal death (6.6 deaths/million maternities with a rate similar to the previous triennium. (4,5)

Improving healthcare of women during childbirth in order to prevent and treat

postpartum haemorrhage is the essential step towards the achievement of Millennium Development Goal 5 (MDG 5). One of the most preventable tragedies for motherhood is postpartum haemorrhage (PPH). In India PPH contributed to 38% of all maternal deaths. (6)

Most deaths and severe morbidities occur because of delayed and/or substandard care in the diagnosis and management of hypovolemic shock (7-11). In LMICs, where women often deliver outside facilities, with unskilled or no attendants, mortality rates are higher and delays are longer because of transportation and referral difficulties. The keys to reducing haemorrhage related adverse maternal outcomes are early recognition, prompt intervention, and timely referral.

Primary PPH is the loss of 500 ml or more of blood from the genital tract in the vaginal delivery and more than 1000 ml after caesarean section within 24 hours of the birth of a baby. (12)Secondary PPH is defined as abnormal or excessive bleeding from the birth canal between 24 hours and 12 weeks postnatal (13)

The shock index (SI), HR/SBP, has been proposed as an earlier marker of compromise than conventional vital signs The normal Shock index (SI) range is 0.5–0.7 for healthy adults .index (SI), defined as the ratio of heart rate (HR) to systolic blood pressure (SBP), has been suggested as a marker for shock, persistent decreased central venous oximetry, and lactic acidosis in patients.(14)

This study aimed to determine the vital sign that best predicts adverse maternal outcomes following PPH, and to develop threshold points: SI>1, indicating the need for referral to a higher level care facility; and >1.5, to identify patients who require urgent action, regardless of the setting.

Aims & Objectives

To compare the predictive value of the shock index (SI) with conventional vital signs in postpartum haemorrhage and to calculate the relationship of shock index with adverse maternal outcome in post partum haemorrhage.

Materials and methods

The study was a hospital based analytical type of observational study conducted in Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur from March ' 2015 to March ' 2016.All full term vaginal delivered women with blood loss of ≥500 ml were taken as cases **.**Patients were evaluated after informed consent. Detailed history (including menstrual history, obstetrical history, Intrapartum, Peripartum, past and family history) was taken. General physical, systemic and gynaecological examination was done. Relevant blood investigations were done. Vitals were recorded immediately following recognition of PPH and they were included in the analysis. Shock index (SI), mean arterial pressure (MAP) and pulse pressure (PP) were calculated. Adverse clinical outcomes were evaluated which included admission to a intensive care unit (ICU), need for blood transfusion≥2 unit, haemoglobin level <7 gm/dl and surgical interventions to staunch bleeding (hemostatic uterine suturing, uterine repair, internal iliac artery ligation, bilateral ligation of internal iliac arteries, hysterectomy) .Statistical analysis was performed by SPSS program for windows, version 10.1 (SPSS, Chicago, Illinois). A receiver operating characteristics (ROC) analysis was calculated to determine optimal cutoff values for SI. The area under the curve and its standard deviation (AUC), the sensitivity, and the specificity was calculated to analyze the diagnostic accuracy of all these markers. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

Observations and results

The data thus obtained were analyzed and the observations made are summarized in the ensuing tables. The table no.1 shows all the patient characteristics in detail.

The table no. 2 depicts that SI was the best predictor for ICU admission (AUROC value is 0.843), haemoglobin (AUROC value is 0.702) and surgical procedure (AUROC value is 0.847) as it has the highest AUROC VALUE for all adverse outcome than other conventional vital signs . For blood transfusion heart rate was the better predictor and SI was the second best predictor.

The table no. 3 depicts the individual values of cut off of SI for all the adverse outcomes and there sensitivity, specificity, PPV, NPV and accuracy.

The data of table no.4 shows comparison of performance of the upper limit of SI>0.7 and SI>0.9. It concluded that for all adverse outcomes SI>=0.9 was the superior predictor. For all adverse outcomes at SI>=0.9 they had similar sensitivities with improved specificity.

The table no.5 shows performance of shock index at two thresholds >=1.5 and >=1.7 with adverse clinical outcome among women with PPH. For all outcomes, SI >=1.7 was superior predictor that is with similar sensitivities and improved specificity.

Table 1: Patient characteristics.

Mean age at delivery 24.97 ± 3.14	
Parity at entry	
P1	52
P2	23
P3	25

Table 2: AUROC VALUES (95% confidence interval) of performance of vital sign parameters to predict adverse clinical outcome among women with PPH.

	ICU admission	Blood transfusion	Haemoglobin	Surgery
SI	0.843 (0.740 - 0.946)	0.884 (0.755 - 1.012)	0.702 (0.588 - 0.817)	0.847 (0.742 - 0.952)
HEARTRATE	0.776 (0.652 - 0.900)	0.939 (0.887 - 0.991)	0.676 (0.554 - 0.797)	0.767 (0.640 - 0.894)
SYSTOLICBP	0.833 (0.724 - 0.943)	0.752 (0.578 - 0.925)	0.683 (0.572 - 0.794)	0.840 (0.719 - 0.961)
DIASTOLICBP	0.807 (0.697 - 0.918)	0.719 (0.560 - 0.878)	0.647 (0.535 - 0.758)	0.788 (0.647 - 0.928)
MAP	0.807 (0.697 - 0.918)	0.753 (0.578 - 0.928)	0.643 (0.526 - 0.759)	0.799 (0.667 - 0.932)
PP	0.651 (0.530 - 0.773)	0.657 (0.481 - 0.833)	0.587 (0.467 - 0.707)	0.653 (0.523 - 0.783)

Table 3: ROC cutoff values of SI for all adverse outcomes and its sensitivity, specificity, PPV, NPV and accuracy.

	Cut off value of SI	Sensitivity	Specificity	PPV	NPV	Accuracy
ICU admission	1.25	69.20%	87.80%	73.5%	98.5%	90.0%
Blood transfusion >=2 units	0.785	88.2%	85.7%	98.8%	35.3%	88.0%
Haemoglobin<7 gm/dl	0.92	66.2%	69.0%	83.9%	45.5%	67.0%
Surgery	1.25	71.4%	84.8%	55.6%	91.8%	82.0%

Table 4: Performance of SI>=0.7 and >=0.9 in predicting adverse outcome in PPH.

Outcome	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
ICU Admission					
SI>=0.7	96.20%	11.00%	25.80%	66.70%	27%
SI>=0.9	96.20%	56.20%	35.71%	96.67%	54%
Blood transfusion					
SI>=0.7	93.00%	17.20%	94.7%	40%	92%
SI>=0.9	66.20%	69.00%	98.5%	17.6%	71%
Hb<7g/dl					
SI>=0.7	95.20%	11.40%	71.6%	40%	70%
SI>=0.9	95.20%	54.40%	80.3%	47.1%	69%
Invasive surgical procedure					
SI>=0.7	93.50%	57.10%	21.1%	80%	24%
SI>=0.9	59.10%	85.70%	30.3%	97.1%	53%

Table 5: performance of SI>=1.5 and >=1.7 in predicting adverse outcome in PPH.

Outcome	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
ICU Admission					
SI>=1.5	46.20%	98.60%	92.9%	84.9%	86%
SI>=1.7	26.90%	100.00%	100%	82.2%	84%
Blood transfusion					
SI>=1.5	16.90%	96.60%	100%	8.1%	21%
SI>=1.7	09.90%	100.00%	100%	7.8%	17%
Hb<=7g/dl					
SI>=1.5	47.60%	96.20%	92.9%	32.6%	41%
SI>=1.7	28.60%	98.70%	90%	31.1%	37%
Invasive surgical procedure					
SI>=1.5	14.00%	100.00%	78.6%	88.4%	87%
SI>=1.7	07.50%	100.00%	80%	85.6%	85%

Discussion

our study evaluated the predictive ability of SI in PPH according to multiple clinical outcomes.the performance of upper limit Our study evaluated the predictive ability of SI in PPH according to multiple clinical outcomes. The performance of the upper limits of SI ≥0.7 and SI ≥0.9 were tested. For most outcomes, SI ≥ 0.9 was the superior predictor and thus may be a valuable threshold in LMICs, where mortality is highest and often related to delays in complication recognition, transportation, and level of care of the facility. A threshold of SI ≥0.9 should be tested to alert community healthcare providers of the need for urgent transfer.

Two potential SI thresholds indicating a high risk of adverse events: SI ≥1.5 and SI ≥1.7 were selected to compare the results

with the other studies Nathan H.L et al.(2014)(15). For all outcomes SI ≥1.7 was the superior predictor: i.e. with similar sensitivities but improved specificity. This second threshold of SI ≥1.7 could be tested as the 'red' trigger to identify the most seriously ill patients, even in higher-level facilities, where deaths occur because of delayed shock recognition. The utility of SI may have greatest impact in low-resource settings; however, community health practitioners may not have access to technology enabling SI calculation. In these circumstances, by identifying when HR exceeds SBP, it should be understood that SI >1 indicates a need for intervention. H.L.Nathan et al.(2014)(15) supported 0.9 as a referral threshold using multiple adverse outcomes and SI>1.7 for urgent medical intervention and Le bas et al.(2014)(16) reported a higher value of 1.1 as indicative of transfusion requirement but suggested 1.0 for simplification of use within an acute obstetric emergency Thus my study suggested cutoff of SI >=1.25 for ICU admission and invasive surgical procedure and SI>=0.92 for haemoglobin<7g/dl and need for blood transfusion.

Conclusion

Finally to conclude, shock index is a effective indicator of outcome in PPH .It is superior to all other conventional vital signs in early recognition of PPH and prompt treatment. SI is a consistently strong predictor of adverse clinical outcomes, even after adjusting for confounding factors. We propose thresholds of SI ≥0.9 for indicating the need for referral to a higher-level facility and SI ≥1.7 for indicating the need for urgent intervention, with the aim of promptly identifying and managing obstetric shock to reduce maternal adverse events in resource poor settings.

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