

Shock Index in Obstetric Hemorrhage as an Applicable Method to Anticipate Adverse Outcome

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Shock index in obstetric hemorrhage as an applicable method to anticipate adverse outcome

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Abstract

Background

To establish the ability of shock index and the different vital signs to predict the adverse maternal outcomes in the cases of obstetric hemorrhage .

Methods

This prospective - retrospective study comprised patients with primary PPH or hemorrhage due to obstetric cause who were referred to zagazig University hospital Egypt , from January 2018, to December 2019 . Data of vital signs of them ; systolic and diastolic blood pressure, pulse rate, pulse pressure, mean arterial pressure and shock index (heart rate divided by systolic blood pressure) at time of arrival were investigated . Adverse outcome like ,death , admission to the intensive care unit , massive transfusion and invasive procedures were revised and analyzed. AUROC (area under the receiver operating characteristic curve) was used for shock index in comparison to each vital sign for predicting the adverse maternal outcomes. Sensitivity, specificity, and negative and positive predictive values were assessed to detect the best predictor.

Results

The mean age of participants years (SD)was 29.2 (±7.3) . of admission and 44% had altered . The most Common cause of hemorrhage was Iatrogenic ; either misuse of uterotonic or traumatic 30.2%

The mean value of HR 108.1±26.6 , SBP 101± 28.7 mmHg , DBP 58.9±21.3 mmHg , SI 1.153±0.541 and mean blood loss 1922 (0.862) .For death, SI and SBP had the highest AUC value at 0.88 (0.81–0.95)with P=0.213 .). For ICU blood transfusion ≥ 5iu , admission and invasive surgical interventions, SI had the uppermost AUROC value at 0.76 , 0.78 and 0.61.

Sensitivity for all adverse outcomes of $SI \geq 0.7$, is h from 99 to 90.0 . For death prediction $SI \geq 0.7$ had very low specificity ;0.6{0.2-1.3}and of $SI \geq 0.9$;6.4{2.8-7.1}

Conclusion

Shock index is a strapping applicable predictor of adverse outcomes. for patients who suffering from hypovolemic shock due to obstetric hemorrhage,

Keywords ; Postpartum haemorrhage, shock index, vital signs, hypovolaemic shock .

Background

Universally , Haemorrhage due to obstetric cause remains the foremost reason of maternal morbidity and mortality 99% of them happen in low- and middle-income countries .1

The primary condition of women with obstetric hemorrhage may be recognized by the quantity of blood . 2 Visual estimation of blood loss was recommended as the standard for blood loss measurement by WHO although it may be underestimated by up to 33%–50 % before the transferal and even after the arrival of the patient.3Assessment of pregnant ladies with an emergency like hemorrhage outside facilities, with inexpert or no assistants and delaying of transportation due to referral difficulties, increases the incidence of adverse outcomes .4 The basic strategy to reduce that haemorrhage-related outcomes is early recognition, rapid intervention, and well-timed referral.5

As , Visual estimation of blood loss miscalculates thus, vital signs like systolic blood pressure

(SBP) and heart rate (HR) are used to evaluate haemodynamic stability .6

During pregnancy and postpartum, there are haemodynamic changes which may postponement the detection of hypovolaemia .Blood pressure falls when pregnant females lose around 30% of their blood volume, But ,at the time of severe bleeding the sympathetic tone is activated instantly to keep the blood pressure and so , the heart rate is increased over blood . 7

Consequently, The shock index (SI) which was estimated as HR/SBP , has been suggested as an former indicator of compromise than conventional vital signs in non-pregnant people .8,9

SI has also been planned as a dependable marker of compromise In an obstetric residents.10

.It has been suggested that ; normal SI in non-pregnant people 0.5–0.7 11 and $SI \geq 0.9$ matches with high incidence of mortality and morbidity.12 "shock index alterations, reflect the hemodynamic response to blood loss and announce the occurrence of adverse maternal outcomes" .13

Another a significant predictor of maternal adverse outcome is coagulopathy , Nevertheless, it frequently yields ≥ 30 minutes to get the results , Also ,the samples of blood may coagulate easier when there is not enough blood of the sample like in the case of hypovolemia associated with obstetric hemorrhage and so delaying in management .14

Few studies have assessed SI as a marker to predict adverse outcomes in referred patients suffering from Postpartum or obstetric hemorrhage. So , The current study was designed to evaluate SI and the other vital signs, as predictor markers of

different adverse maternal outcomes amongst patients with obstetric hemorrhage that were referred to our tertiary hospital .

Methods :

It is a prospective -retrospective study of 242 ladies admitted with postpartum hemorrhage(PPH) to obstetric emergency unit at zagazig University tertiary hospital, Egypt from January 2018, to December 2019. Approval on the study was taken from the institutional committees of Zagazig University Hospital . Informed written or thumbprint consent was taken from All women or their relatives if they were unconscious or confused at time of admission . Participation of Women was depended on reaching to level of valued blood loss >750ml and systolic blood pressure (SBP)< 100 mm Hg and/or pulse rate >100 beat /minute(BPM)

Predictor variables involved , Vital signs ; {pulse, SBP, diastolic blood pressure (DBP), mean arterial pressure (MAP = (2 x DBP + SBP)/3), SI (pulse/SBP), and pulse pressure (SBP-DBP). Automated blood pressure device or auscultatory technique with mercury sphygmomanometer was used to measure blood pressure .} and shock index (heart rate divided by systolic blood pressure) were documented at 15 minute breaks, till the source of bleeding was found and managed as patient became vitally stable (SBP \geq 100mm Hg, pulse rate \leq 100 BPM) for at least 2 hours, and blood loss had declined to almost 25–50mL per hour.

Severe shock at study entry was defined as MAP < 60 mmHg, as perfusion of blood to vital organs has been probably affected .¹⁵The lower verge of the shock index was choiced as \geq 0.7 that was identified as the higher edge of normal shock index in a non-pregnant People,² and \geq 0.9 as the upper one of normal Instant postpartum.^{16,17} The management was primarily with ordinary practice comprising intravenous hydration, manual massages, ice packs and/or uterotonics,

Adverse maternal outcomes like ; death, , ICU admission, massive blood transfusion and critical interventions outcome including blood transfusion \geq 5 units , admission atintensive care unit, or emergency hysterectomy were documented all .Data were analyzed with SPSS version 19.0 (IBM, Chicago, IL, USA) and MedCalc 16.4.1 (MedCalc Software bvba, Ostend, Belgium). Calculation of Sensitivities, specificities, and positive and negative predictive values was done . Differences were considered statistically significant at P < 0.05.

Results :

242 women were women referred to our hospital due to obstetric haemorrhage Demographics criteria of the participants at the stage of study entrance are presented in

Table 1 . The mean age of participants years (SD) was 29.2 (±7.3) . 56 % of the participants were alert at time of admission and 44% had altered consciousness. The most Common cause of hemorrhage was Iatrogenic ; either misuse of uterine relaxants or traumatic 30.2% then uterine atony (29.1%) and last cause was molar pregnancy complications 0.7% .

Table 2 ; represents the (mean ± SD) values of vital signs of the participants . The mean value of HR 108.1±26.6 , SBP 101± 28.7 mmHg , DBP 58.9±21.3 mmHg , SI 1.153±0.541 and mean blood loss 1922 (0.862) . Table 3 shows the performance of SI (Shock index) and other vital sign parameter

in predicting the adverse clinical outcomes. For death, SI and SBP had the highest AUC value at 0.88 (0.81–0.95) with $P=0.213$. and significantly higher than pulse rate ($p=0.031$) and pulse pressure ($p=0.022$). As regard ICU admission, It had the uppermost AUROC value at 0.76(0.64-0.88) which was significantly higher than for SBP ($P = 0.024$), DBP ($P = 0.012$), MAP ($P = 0.024$), and PP ($P = 0.002$), But , pulse rate (PR) ($P = 0.818$) is not significantly higher than SI (Shock index) .

About blood transfusion ≥ 5 iu, SI had the highest AUROC 0.78, which was significantly higher than for SBP ($P = 0.034$), DBP($P = 0.029$), MAP ($P = 0.025$), and more significant than pulse pressure ($p=0.001$) but not that of pulse rate ($P = 0.708$),

For invasive surgical interventions, the shock index had the highest AUROC value at 0.61 (0.46-0.79) which was statistically, not significantly higher than for systolic BP ($P=0.074$), diastolic BP, heart rate or MAP ($P=0.289$, $P=0.472$ and $p=0.344$, respectively). But it had significant difference more than pulse pressure ($P = 0.0411$) .

Table 4 shows the convenience of $SI \geq 0.7$ and $SI \geq 0.9$ as early predictors of adverse outcome of postpartum haemorrhage . Of the 242 women encompassed in This study, there were 212 (88%) with $SI \geq 0.7$ and 133 (55%) with $SI \geq 0.9$.

Sensitivity for all adverse outcomes of $SI \geq 0.7$, is high from 99 to 90.0 . which is high specifying that approximately all positives are exactly recognized as such while several negatives are categorized as false positives . For death prediction $SI \geq 0.7$ had very low specificity ;0.6{0.2-1.3} and of $SI \geq 0.9$;6.4{2.8-7.1}

As all of the women in the study had hypovolemic shock, the high rate of positive test results is clinically acceptable .

Discussion :

The current study evaluates the role of shock index as an indicator for prediction of adverse outcome in patients referred due to obstetric hemorrhage in Comparison with other vital signs . Numerous studies have investigated the efficiency of the shock index in PPH like Nathan et al. 18 who established that, comparing it with further vital signs,. He found that SI and HR were significantly better predictors than all other vital signs For ICU admission, but for transfusion ≥ 4 iu, SI had the highest AUROC value, performing significantly better than HR . Lee et al 2018 19 found that ;The shock index was ominously useful for prediction of massive transfusion but for invasive procedures and ICU admission; shock index and pulse rate had higher AUROC values than blood pressure.

Our study established that ; SI for ICU and massive blood transfusion ≥ 5 iu had more significant prediction than SBP (0.024 , 0.034), DBP (0.012,0.029), MAP (

0.02 ,0.025)and PP (0.002 , 0.001). As regard the pulse rate ; SI had the same significance .About surgical interference ; SI had more significance than SBP and PP(0.07 , 0.041) and the same significancy of DBP , PR and MAP .

Sohn et al.²⁰ stated that the shock index is a predictor of massive bleeding and the initial shock index is individualistically associated with massive transfusion.¹³ , but they did not study other adverse outcomes, for example ICU admission or invasive procedures .and These results are similar to those results of Nathan et al.¹⁸ .Predictable vital signs have been revealed to be late markers of haemodynamic Compromise in obstetric and even non- obstetric people .SI may aid Observing such cases with modify management to reduce the adverse outcomes via resuscitation and referral at time .

The current study examined the performance of the upper limits of $SI \geq 0.7$ and

$SI \geq 0.9$.Lee et al suggested that $SI \geq 0.9$ expects adverse events like massive transfusion and invasive procedures So, can take right decisions of the management (time and type) .This agreed with our results. El Ayadi et al.²¹ found that $SI \geq 0.9$ indicates a need for referral, as their this study was directed in a low-resource setting where necessary resuscitation for emergency patients with obstetric hemorrhage are insufficient or suboptimal; consequently, the results can be generalized to our communities

Conclusion

Shock index is a strapping applicable predictor of adverse outcomes for patients who suffering from hypovolemic shock due to obstetric hemorrhage, and $SI \geq 0.9$ Specifying the need for referral to tertiary place or rough nursing inside tertiary care.

Abbreviations

PPH : primary PPH or hemorrhage

AUROC : area under the receiver operating characteristic curve

SI: Shock Index

SBP : systolic blood pressure

DBP : diastolic blood pressure

MAP : mean arterial pressure

ICU : Intensive care unit

PP : pulse pressure

PR : pulse rate

Disclosure

The contents of this publication are solely the responsibility of the authors.

Limitations

our interpretations are limited to a somewhat small sample that means need to a large one to be studied in the future. The protocol of management pre referral was different thus the outcome of patients might be affected .

Recommendations

Prospective studies on large number of patients suffering from obstetric haemorrhage is required to optimally appreciate the value of the shock index mainly in low source outcome setting

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable.

Availability of data and materials

The dataset for the current study is available from the corresponding author upon receipt of a reasonable request .

Competing interests

The authors declare they have no competing interests.

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Authors' Contributions

The all authors confirm full responsibility for study conception and design, analysis and interpretation of results, and manuscript preparation. Also ,All authors were involved in developing and drafting the manuscript. The final version is read and approved by all authors.

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Not Applicable

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Table (1): Characteristics of Participants

Character	N (242)	%
Age	29.2 (7.3) _a	
Parity		
P0		3.4
P1		10.1
P2		36.2
P≥3		50.3
Body mass Index (BMI)	27.3 (4-7)	
level of consciousness		
alert		56
altered		44
Mode of delivery		
Vaginal	39.1	
Caesarean section	60.9	
Obstetric causes		
Iatrogenic	73	30.1
●Misuse of ecopolics	48	19.8
●Traumatic	25	10.3
Atonic	70	28.9
Placenta aacreta	41	16.9
Placenta previa	29	12
Ectopic	21	8.6
Abortion	6	2.4
Molar pregnancy	3	1.2

Values presented as Mean (SD) , N=number or %= percentage

Table 2 (Mean ± SD) Values of different vital signs

Variable	Value
Shock Index (SI)	1.153±0.541
Pulse rate, beats per min	108.1±26.6
Systolic blood pressure (SBP)mmHG	101.8±28.7

Diastolic blood pressure (DBP) mmHG	58.9±21,3
Mean blood loss ml (SD)	1922(0.862)

Table 3 Performance of SI(Shock index) and various vital signs using AUROC in predicting mortality and adverse clinical outcome amongst ladies suffered from obstetric hemorrhage .

Adverse clinical outcome	Vital sign										P value
	SI(Shock index)	SBP (Systolic BP)	P value	DBP (Diastolic BP)	P value	PR (Pulse rate)	P value	MAP(mean arterial pressure)	P value	PP (Pulse Pressure)	
Death	0.88(0.81-0.95)	0.89(0.82-0.96)	0.213	0.80(0.70-0.91)	0.201	0.79(0.68-0.88)	0.031	0.84(0.78-0.92)	0.132	0.38(0.27-0.52)	0.022
I CU admission	0.76(0.64-0.88)	0.74(0.65-0.84)	0.024	0.65(0.46-0.85)	0.012	0.64(0.45-0.83)	0.818	0.65(0.45-0.84)	0.024	0.56(0.41-0.68)	0.002
Blood transfusion ≥5iu	0.78(0.72-0.82)	0.70(0.65-0.74)	0.034	0.71(0.64-0.74)	0.029	0.81(0.77-0.84)	0.708	0.71(0.66-0.77)	0.025	0.49(0.46-0.57)	0.001
Invasive surgical intervention	0.61(0.46-0.79)	0.59(0.47-0.81)	0.074	0.56(0.41-0.76)	0.289	0.58(0.37-0.78)	0.472	0.57(0.36-0.61)	0.344,	0.49(0.37-0.61)	0.041

AUROC, (95% confidence interval).area under the receiver operating characteristic curve; ICU, intensive care unit;

Table 4. showed the predictive value of shock indexes of ≥ 0.7 and ≥ 0.9

Outcomes	SI	Sensitivity (95% CI)	Specificity (95% CI)	Positive predictive value (95% CI)	Negative predictive value (95% CI)
Death	SI ≥ 0.7 SI ≥ 0.9 .	99.0{91-100} 99.0{91-99}	0.6{0.2-1.3} 6.4{2.8-7.1}	5.0{1.9-4.6} 5.6{2.8-4.9}	99.5{38.7-99.8} 99.6{93.7-98.9}
Icu admission	SI ≥ 0.7 SI ≥ 0.9	98.0{78-98.1} 97.0{79.3-99.8}	13.2{9.8-18.7} 41.2{32.7-49.2}	7.1{2.9-11.1} 9.1{3.9-13.9}	99.8{87.2-100} 99.6{95.1-100}
Massive Blood transfusion	SI ≥ 0.7 SI ≥ 0.9	93.0{80-97.0} 81.0-{66.6-92.8}	16.3{11.2-20.7} 43.5{36.1-48.9}	19.1{12.8-23.8} 22.6{17.1-30.9}	89.9{76.1-97.8} 90.8{84.1-95.8}
Invasive surgical intervention	SI ≥ 0.7 SI ≥ 0.9	90.2{60.7-98.5} 85.6{52.5-96.1}	13.9{8.9-18.8} 41.9{36.1-48.9}	6.1{3.1-10.1} 8.1{4.2-12.9}	97.1{82.7-98.8} 98.2{91.8-99.6}