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RESEARCH ARTICLE

Impact of non pneumatic anti shock garment in reducing postpartum haemorrhage - a tertiary centre experience

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ABSTRACT

Objective: To compare the effect of a non-pneumatic anti-shock garment (NASG) on blood loss from obstetric haemorrhage with standard management of obstetric haemorrhage. M**ethods:** This is an observational study of consecutive obstetric haemorrhage cases before and after the introduction of the non-pneumatic anti-shock garment conducted in a tertiary care centre in Southern India. A total of 122 women were included in the study out of which, 48 women were in the pre-intervention group and 74 in the post-intervention group. Blood loss was measured and recorded before and after the introduction of NASG. **Results:** The number of patients with significant blood loss (>750 ml) decreased from 81.3% to 50% after the use of NASG. The number of women with shock index >0.7 also reduced significantly from 81.3% to 56.8% thus reflecting the lower number of women requiring blood transfusion in the post-intervention group (56.2% v/s 14.9%). There was also a decrease in the number of cases requiring surgical management in the post NASG intervention group with a significant p-value of <0.001. However, no significant difference was noted in terms of the rate of intensive care unit (ICU) admissions or mortality rates among the two groups. Interestingly, improved perinatal outcomes were noted in the post-intervention group in the form of increased live birth rates and reduced neonatal admissions. **Conclusions:** NASG shows promise for the management of obstetric haemorrhage, particularly in lower resource settings.

Keywords: Blood loss, intervention, non-pneumatic anti-shock garment, obstetric haemorrhage.

Obstetric haemorrhage (OH), including postpartum haemorrhage (PPH), is the leading cause of maternal mortality worldwide, particularly in low-resource settings where access to blood and surgery is limited. About 30% of direct maternal deaths are caused by OH, the vast majority of which occur in developing countries.[1, 2] In low-resource settings, a series of delays contribute to high maternal mortality: the decision to seek care, procuring transport and reaching a comprehensive emergency obstetric care facility, and obtaining quality definitive care.[3] One new low-technology first-aid device for stabilizing women suffering hypovolemic shock secondary to obstetric haemorrhage is the non-pneumatic anti-shock garment (NASG), a lower body compression garment made of neoprene and velcro.

The NASG is a simple, relatively inexpensive, lightweight, reusable compression suit, comprising five neoprene segments that close tightly with velcro around the legs, pelvis, and abdomen. The abdominal segment incorporates a small foam pressure ball to supply uterine compression.

The entire garment, when tightly applied by one person, supplies 20–40 mmHg circumferential pressure. This lower body circumferential counter pressure shunts blood from the lower extremities and abdominal area to the essential core organs: heart, lungs, and brain. [4, 5]

The NASG plays a unique role in haemorrhage and shock management by reversing shock and decreasing blood loss thereby stabilizing the woman until definitive care is accessed. Previous studies of the NASG at tertiary care facilities have shown significantly reduced measured blood

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loss, more rapid recovery from shock, and decreased mortality.[6]

Materials and methods

Women with obstetric haemorrhage with blood loss of more than 750 ml and either pulse of more than 100 beats per minute or systolic blood pressure of <100 mm Hg were included in the study. All women with obstetric haemorrhage meeting the eligibility criteria were treated according to the standard protocol in the initial 4 years (2010-2014) and with a standard protocol with NASG additionally after that period (2014-2017). Demographic details, diagnosis at admission, progression to complications, amount of blood loss, need for blood and blood products, need for surgical management, and maternal and fetal outcome data before and after the introduction of NASG were obtained from records.

Women were eligible regardless of whether they began to haemorrhage outside the facility and were transferred in, or began to haemorrhage in the facility. All etiologies of obstetric or pregnancy-related haemorrhage were included: complications of abortion, ectopic pregnancy, trophoblastic disease of pregnancy, problems of placentation, ruptured uterus, abruption of placenta, uterine atonicity, and lacerations.

During the pre-intervention phase (2010-2014), women were managed with a standardized, evidence-based haemorrhage and shock protocol; the intervention phase (2014-2017) included the NASG in this protocol. The standardized protocol for both phases included: the administration of oxygen, IV crystalloid fluids (>1500 ml in the first hour), and establishing the aetiology of the haemorrhage. If the haemorrhage was due to uterine atony, uterotonics were administered, including oxytocin, ergometrine, and misoprostol, and uterine massage or bimanual compression was performed. Depending on the source of the bleeding, the protocol included repair of lacerations, vaginal procedures such as manual vacuum aspiration or curettage to remove retained products and manual removal of retained placenta. Exploratory laparotomy was conducted and procedures were performed, such as a salpingectomy, for a ruptured ectopic pregnancy, repair of a ruptured uterus, or an emergency hysterectomy based on the case.

The protocol included laboratory investigations, such as complete blood count, serum creatinine, blood grouping, typing and cross-matching, and tests to rule out coagulopathies. Urine output was measured using either a Foley catheter to a calibrated drainage bag or a straight catheter to a graduated collection bottle. Finally, the protocol called for a blood transfusion for all women with signs of shock. Blood loss after entry into the study in both phases was measured using a closed-end, calibrated, plastic blood collection drape. If the woman required a vaginal procedure, the NASG was left completely in place. If she required a laparotomy, the abdominal and pelvic segments were opened immediately prior to making the incision, and then replaced when the surgery was completed. Thus, data regarding demographic details, diagnosis at admission, progression to complications, amount of blood loss, need for blood and blood products, need for surgical management, and maternal and fetal outcome data before and after the introduction of NASG were obtained from records and results tabulated.

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on the mean ± SD (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5 % level of significance. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on a categorical scale between two or more groups in, a non-parametric setting for qualitative data analysis. Fisher exact test is used when cell samples are very small. Logistic regression analysis was employed to find the correlation of positivity with clinical variables (Adj OR=1 - no relationship, Adj OR>1 - positive association and Adj OR <1 - negative association). The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and excel have been used to generate graphs, tables etc.

Results

A total of 122 women were enrolled in the study. Out of which 48 cases belonged to the pre-intervention group (2010-2014) and 74 cases belonged to the post-intervention group (2014-2017). The baseline information of all the cases including age, gestational age, referral status and the medical and obstetric risk factors associated with obstetric haemorrhage are shown in table 1.

There was a significant reduction in the shock index after the use of NASG as seen in table 2, with the number of women with a shock index > 0.7 reducing from 81.3% in the pre-intervention group to 56.8 % in the post-intervention group with a p-value of 0.042.

There was also a significant reduction in the number of cases requiring surgical intervention with a p-value of < 0.001. Only 4 cases (5.4 %) in the post-intervention group required compression sutures when compared to 9 cases

(18.8%) in the pre-intervention group with a significant p value of 0.02. Similarly, there was a reduction in the total number of obstetric hysterectomies in the post NASG group with 3 cases (4.1%) when compared to 8 cases (16.7%) in the pre-intervention group as shown in table 3.

Table 1: Baseline details

Parameters	Before the use of NASG (N=48)	After the use of NASG (N=74)	Total (N=122)
Age in years			
<20	4(8.3%)	6(8.1%)	10(8.2%)
20-30	41(85.4%)	58(78.4%)	99(81.1%)
>30	3(6.3%)	10(13.5%)	13(10.7%)
Medical			
Anaemia	1(2.1%)	7(9.5%)	8(6.6%)
Diabetes	1(2.1%)	3(4.1%)	4(3.3%)
Hypothyroidism	0(0%)	3(4.1%)	3(2.5%)
Peripartum cardiomyopathy	0(0%)	0(0%)	0(0%)
Retained placenta	3(6.3%)	0(0%)	3(2.5%)
Cardiac disease	1(2.1%)	0(0%)	1(0.8%)
Gestational age			
Term	32(66.7%)	24(32.4%)	56(45.9%)
28-38 wks	12(25%)	21(28.4%)	33(27%)
<28 wks	4(8.3%)	29(39.2%)	33(27%)
Booked/Referred			
Booked	4(8.3%)	10(13.5%)	14(11.5%)
Unbooked	44(91.7%)	64(86.5%)	108(88.5%)
Obstetric diagnosis			
Severe PIH	5(10.4%)	8(10.8%)	13(10.7%)
Eclampsia	2(4.2%)	3(4.1%)	5(4.1%)
Molar pregnancy	0(0%)	2(2.7%)	2(1.6%)
Placenta praevia	6(12.5%)	7(9.5%)	13(10.7%)
Ectopic	1(2.1%)	4(5.4%)	5(4.1%)
HELLP syndrome	0(0%)	4(5.4%)	4(3.3%)
Abruption	11(22.9%)	12(16.2%)	23(18.9%)
Abortion	1(2.1%)	15(20.3%)	16(13.1%)
Epilepsy	0(0%)	0(0%)	0(0%)
Postpartum haemorrhage	10(20.8%)	15(20.3%)	25(20.49%)
Normal labour	4(8.3%)	2(2.7%)	6(4.9%)
Previous LSCS	2(4.2%)	2(2.7%)	4(3.3%)
Intrauterine death	0(0%)	6(8.1%)	6(4.9%)

There was a significant improvement in live birth rates, and birth weight in the post-intervention group with a p-value of less than 0.01. The rate of neonatal admissions was reduced by half (45.8% in the pre-intervention group to 21.6% in the post-intervention group) with a significant p value of 0.005.

Table 2: Shock index

Shock index	Before the use of NASG	After the use of NASG	Total
>0.7	31(81.3%)	42(56.8%)	81(66.4%)
<0.7	9(18.7%)	32(43.2%)	41(33.6%)
Total	48(100%)	74(100%)	122(100%)

Table 4 compares the amount of blood loss before and after the introduction of NASG. 39 out of 48 cases (81.3%) in the pre-intervention group had blood loss of more than 750ml when compared to 50% of cases in the post-intervention group with a p-value of 0.001. Women in the pre-intervention group had an increased requirement of blood and products with 56.2 % when compared to 14.9 % in the post-intervention group with a p-value of < 0.001.

Table 3: Requirement of surgical intervention

Categories	Before the use of NASG	After the use of NASG	Total	P value
Laparotomy	19(39.6%)	25(33.8%)	44(36.1%)	<0.001**
Requirement of compression sutures				
Yes	9(18.8%)	4(5.4%)	13(10.7%)	
No	39(81.3%)	70(94.6%)	109(89.3%)	0.020*
Obstetric hysterectomy				
Yes	8(16.7%)	3(4.1%)	11(9%)	0.024*

There was a significant reduction in the medical intensive care unit (MICU) admissions in the post-NASG group with 20 out of 74 cases (27%) when compared to 43.8% cases in the pre-NASG group with a p-value of 0.071. There was no significance with respect to the mortality rates before and after the use of NASG in our study. The total number of maternal deaths prior to intervention due to haemorrhage was 4 and post-intervention was 2 (table 5).

Table 4: Blood loss and blood products requirement

Categories	Before use of NASG	After use of NASG	Total	P value
Blood loss >750ml	39(81.3%)	37(50%)	76(62.3%)	<0.001*
Requirement blood & products Required	27(56.2%)	11(14.9%)	38(31.1%)	<0.001**

Discussion

Obstetric haemorrhage is a life-threatening condition contributing to 19.9% of maternal deaths in India.[6] In our study, we had a total of 122 women presenting with obstetric haemorrhage (>750ml blood loss) secondary to complications of abortion, ectopic pregnancy, trophoblastic disease of pregnancy, problems of placentation, ruptured uterus, abruption, uterine atony, and lacerations. Most of the cases of our study (85- 90%) were unbooked and referred from different primary health centres and presented to us in a state of shock after the failure of standard protocols suggesting the importance of the use of NASG in the above setting. In this study, uterine atonicity contributed to 60% of the aetiology in the majority of the cases which corresponds

Table 5: MICU admissions and mortality rates

MICU	Before use of NASG	After Use of NASG	Total	p value
Yes	21(43.8%)	20(27.0%)	41(33.6%)	
NO	27(56.3%)	54(73.0%)	81(66.4%)	
Total	48(100%)	74(100%)	122(100%)	0.071
Mortality	**Before use of NASG**	**After use of NASG**	**Total**	**P value**
No	44(91.7%)	72(94.6%)	116(95%)	
Death	4(8.3%)	2(2.7%)	6(4.9%)	0.1833

to literature as the commonest type of obstetric haemorrhage.[6] Current PPH prevention strategies such as active management of the third stage of labour (AMTSL) and treatment strategies such as administration of uterotonics may not be adequate to address all PPH due to uterine atony. In addition, uterotonics will not address non-atonic etiologies such as lacerations or a ruptured uterus. For women in severe shock secondary to obstetric haemorrhage, the NASG intervention is an economically attractive option for health systems aiming to reduce maternal mortality from haemorrhage and shock. The use of the NASG as part of the standard management of PPH and hypovolemic shock at our hospital was associated with a significant reduction in blood loss, need for blood transfusions, need for surgical management and even when controlling the severity of shock and the number of ICU admissions. Similar results were seen in a study conducted by Miller et al, Mohammed Fathalla et al and Oladosu and Alison et al where the use of NASG reduced blood loss with a significant p-value. [7-10] The need for obstetric hysterectomies was reduced after the use of NASG. This was seen in a study by Miller et al in 2010 where only 4% required surgery when compared to 8.9% in the pre-NASG intervention group which is very similar to our study findings.[6] When we look at the aetiology of obstetric haemorrhage, literature states that uterine atony causes the majority of mortalities due to haemorrhage. But, the use of NASG has reduced this incidence as seen in the study by Miller et al in Nigeria and Egypt where only 29% of cases had uterine atony.[11, 12]

The use of NASG had other positive implications as well. In our study, we found an improved neonatal outcome in the post-intervention group with an increase in live birth rates and a decrease in the number of NICU admissions. This can be secondary to improved maternal hemodynamics in the post-intervention group.

In our study, the maternal deaths secondary to obstetric haemorrhage reduced by 50% after the use of NASG. It is important to stress that NASG is not the final therapeutic solution for haemorrhage but it helps to keep the patient stable till definitive treatment is initiated and thus reducing morbidity. Women in the NASG phase of the study still experienced blood loss, emergency hysterectomies, mortality, and severe morbidities, but at a lower rate than women who did not receive the NASG. Rapid administration of blood, crystalloid fluids, uterotonics, and access to anaesthesia and surgery are responsible for saving the lives of women with PPH. The NASG enables women to survive delays which are inevitable in low-resource settings until they receive the above definitive treatment.

The NASG's simple and inexpensive design is easy to use and apply as a first aid device in low-resource referral facility settings, prior to transfer. These findings show promise for saving women's lives from PPH. The results of this study indicate that the NASG may be a useful tool when added to well-conducted AMTSL and evidence-based haemorrhage and hypovolemic shock protocols.

Conclusion

Maternal mortality is a global public health problem. Obstetric haemorrhage is the leading cause of maternal mortality globally, particularly in low resource settings where long delays contribute to adverse outcomes that would not occur in higher resource settings. While this study indicates the utility of the NASG at the referral facility, in many high maternal mortality rate countries, births occur at home attended by unskilled birth attendants or family members. Therefore, the next step is to evaluate the efficacy of early application of the NASG at the clinic level where it is hypothesized that the NASG will have an even greater impact.

Conflict of interest: None. **Disclaimer:** Nil.

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