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(RESEARCH ARTICLE)

Predictive analysis of maternal subcutaneous fat thickness for the risk of postpartum haemorrhage

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Abstract

The incidence of postpartum haemorrhage has been increasing in several developed countries over the past two decades. Obese women are at increased risk of postpartum hemorrhage. Till date BMI has been used to define obesity. Maternal abdominal subcutaneous fat thickness (SCFT) can be used as a measure for central obesity and can be measured by ultrasound easily. The present study was done to find association between maternal BMI and SCFT with development of PPH and to find a cut-off value of BMI and SCFT for prediction of risk of PPH.

Methods: 200 women with live singleton pregnancy of 16-18 weeks gestation were included in the study after obtaining written informed consent. Maternal abdominal subcutaneous thickness was measured by USG. All women were monitored till delivery and observed for PPH. All data were entered into MS excel sheet and analysed.

Results: Mean BMI was significantly more in women who had PPH (25.85 ± 3.24 vs 22.63 ± 2.80 kg/m^2, p - <0.001). Mean SCFT was significantly more in women who had PPH than in women without PPH (16.12 ± 2.75 vs 12.22 ± 3.00 mm, p - <0.001). On ROC curve analysis, SCFT above 15.7 mm (AUC=0.840) predicted PPH with a sensitivity of 85% and specificity of 86% and associated with approximately 34 times increased risk of PPH [OR 34.1; 95% CI ((7.1383 – 162.49290, p - <0.0001].

Conclusion: Maternal abdominal subcutaneous fat thickness measured at 16 to 18 weeks of pregnancy by USG is a reliable marker to identify women at risk of PPH.

Keywords: Obesity; Body mass index; Abdominal subcutaneous fat thickness; PPH

1. Introduction

Postpartum haemorrhage (PPH) is a leading cause of maternal mortality and severe morbidity; particularly in low-income countries [1]. Approximately 3% to 5% of obstetric patients will experience postpartum hemorrhage [2]. The incidence of postpartum haemorrhage has been increasing in several developed countries over the past two decades; with rates rising by over one third [2;3]. Various reasons speculated for this increase in PPH are rise in maternal obesity [4]; previous Caesarean section [5]; multiple pregnancy [5;6] and differences in the management of labour (including induction and augmentation of labour and epidural anaesthesia)[2;7].

Data from several population-based studies suggest that obese women are at increased risk of postpartum hemorrhage or atonic hemorrhage [8]. In other studies; obesity is reported to have a protective effect [9] or no association with

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postpartum hemorrhage [10]. Labour dystocia; uterine atony; tissue injury and surgical morbidity occur more commonly in obese women than non-obese women [11]. These factors may contribute towards a greater risk of postpartum hemorrhage for obese women undergoing cesarean delivery than for women undergoing vaginal delivery with comparable body mass index [12].

Obesity has become a major health issue across the world. In the United States; the prevalence of maternal obesity has been steadily rising; with more than half of pregnant women classified as overweight or obese [13]. Recently obesity in India has become a pandemic problem. In the Indian subcontinent; the prevalence of overweight or obese (BMI ≥ 25 kg/m2) married women (15–49 years) has risen from 20.6% (NFHS -4; 2015-2016) to 24% (NFHS-5; 2019-2021) [14]. Till date BMI is most frequently used parameters to define obesity and risk assessment of obesity-related pregnancy complications. BMI does not account for the amount of muscle mass or fat distribution or the proportion of adipose to non-adipose tissue [15; 16]. Maternal abdominal subcutaneous fat thickness (SCFT) can be used as a measure for central obesity and can be measured by ultrasound easily [17; 18]. Very few studies done in the past observed that abdominal SFT at mid-pregnancy between 18 and 22 weeks' gestation is superior to BMI to identify risk for obesity-related pregnancy complications [15; 19;20]. The present study was done to find association between maternal BMI and SCFT with development of PPH and to find a cut-off value of BMI and SCFT for prediction of risk of PPH.

2. Material and methods

This was a descriptive observational study conducted in the Department of Ob-Gy. 200 women with live singleton pregnancy of 16-18 weeks gestation were included in the study after obtaining written informed consent. Women with hypertension, diabetes prior to pregnancy or with a previous history of PPH were excluded. BMI (kg/m^2) was calculated by dividing the weight in kilograms by the squared height in meters of the woman at her first antenatal clinic (ANC) visit. Women were categorized into World Health Organization (WHO) BMI categories: underweight (<18.5), normal weight (18.5-24.9), overweight (25-29.9) and obesity (≥30). Ultrasonography was done to assess foetal well-being and rule out congenital malformation. Maternal abdominal subcutaneous thickness was measured from the subcutaneous fat layer to the outer border of the rectus abdominus muscle at the level of the linea Alba. Three measurements were taken for subcutaneous thickness for each woman and mean subcutaneous thickness was determined. Women with SCFT <15 mm were considered normal and with SCFT ≥15 mm were considered obese. All women were monitored till delivery. Mode of delivery and neonatal outcome were noted. Women were observed for PPH. PPH was defined as blood loss >500 ml in vaginal delivery and > 1000 ml in LSCS.

All data were entered into MS excel sheet and analysed. To determine the cut-off value BMI and SCFT for predicting PPH a receiver operating characteristic (ROC) curve analysis was conducted, with the area under the curve (AUC), sensitivity, and specificity calculated. A logistic regression analysis was done to calculate the odds ratio for the SCFT mediated risk of PPH. A p value <0.05 was considered to be statistically significant.

3. Results

Table 1 Profile of the women

Variables	PPH (n=13)		Without PPH (n=187)		Odd Ratio (95%CI)	P value
	No	Percentage	No	Percentage		
Age (Years)						
<25	3	23.1	104	55.6	4.17 (1.1134-15.6679)	0.03
≥25	10	76.9	83	44.4		
Gravida						
G 1	2	15.4	84	44.9	4.48 (0.9674-20.7970)	0.05
G ≥2	11	84.6	103	55.1		
Mode of Delivery						
LSCS	9	69.2	56	29.9	5.26 (1.5560-17.8045)	0.007
ND	4	30.8	131	70.1		

In our study 30 women (15%) out of 200 women were overweight or obese. PPH was observed in 13 women (6.5%) out of 200 women. Out of 13 women who had PPH, 23.1% women were below 25 years and 76.9% women were 25 years of age or above. Women who were 25 years or above were 4 times more at risk of having PPH [OR 4.17; 95%CI (1.1134-15.6679) (p =0.03)]. Women with gravida 2 or more had approximately 4.5 fold increased risk of PPH [OR 4.48; 95%CI (0.9674-20.7970) (p =0.05)]. Women with LSCS were 5 times more at risk of PPH [OR 5.26; 95%CI (1.5560-17.8045) (p =0.007)]. (Table 1)

Mean age of the women who had PPH was significantly more than mean age of the women without PPH (27.77 ± 2.8 vs 23.89 ± 2.69 years, p - <0.001). Mean BMI of the women who had PPH was significantly more than mean BMI of the women without PPH (25.85 ± 3.24 vs 22.63 ± 2.80 kg/m², p - <0.001). Mean SCFT of the women who had PPH was significantly more than mean SCFT of the women without PPH (16.12 ± 2.75 vs 12.22 ± 3.00 mm, p - <0.001). (Table 2).

Table 2 Association of Age, BMI and SCFT with PPH

Variables	Total (n=200)	PPH (Yes) (n=13)	PPH (No) (n=187)	P value
Mean Age (year)	24.17 ± 2.86	27.77 ± 2.8	23.89 ± 2.69	<0.001
Mean BMI (kg/m^2)	22.84 ± 2.93	25.85 ± 3.24	22.63 ± 2.80	<0.001
Mean SCFT (mm)	12.47 ± 3.13	16.12 ± 2.75	12.22 ± 3.00	<0.001

To find an effective cut-off value for predicting PPH by BMI and SCFT, a ROC curve analysis was conducted which showed that BMI above 24.4 kg/m^2 (AUC=0.821) predicted PPH with a sensitivity of 77% and specificity of 80% and Youden index of 0.57. ROC curve analysis for SCFT showed that SCFT above 15.7 mm (AUC=0.840) predicted PPH with a sensitivity of 85% and specificity of 86% and Youden index of 0.48. Positive predictive value of BMI and SCFT was 21% and 29% respectively. Negative predictive value of BMI and SCFT was 98% and 99% respectively. SCFT was better than BMI in predicting PPH and there was no significant difference in the diagnostic performance of BMI (Kg/m^2) and SCFT (mm) in prediction of PPH (DeLong's Test p = 0.657). (Table 3 and Fig 1)

Table 3 ROC curve analysis for diagnostic performance of BMI and SCFT for prediction of PPH

Predictor	AUROC	Sensitivity %	Specificity %	PPV (%)	NPV (%)	Youden Index	P value
BMI (24.4 Kg/m^2) By ROC	0.821	77	80	21	98	0.57	<0.001
SCFT (15.7 mm) By ROC	0.840	85	86	29	99	0.48	<0.001

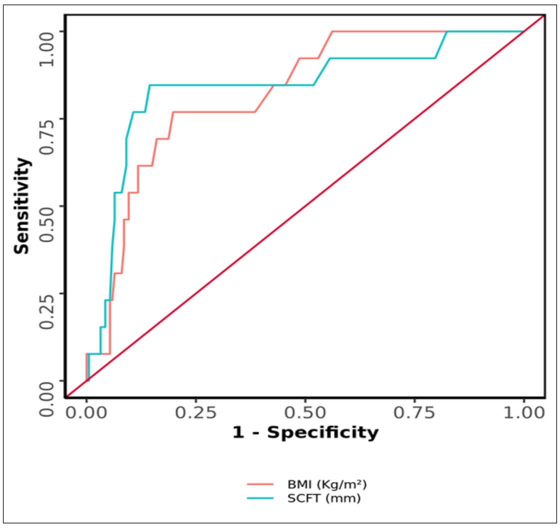

Figure 1 Diagnostic Performance of BMI & SCFT in predicting PPH

Increased BMI and SCFT were significantly associated with increased risk of developing PPH. BMI at a cut-off value of 25 kg/m² was associated with approximately 12 times increased risk of PPH [OR 12; 95% CI (3.6047 – 39.948), P - 0.0001]. BMI at a cut-off 24.4 kg/m² (by ROC curve) was associated with approximately 38 times increased risk of PPH [OR 38.2; 95% CI (4.2058 – 61.9823); p - 0.0001]. Abdominal SCFT at a cut-off of 15 mm was associated with approximately 23 times increased risk of PPH. SCFT at a cut -off 15.7 mm (by ROC curve) was associated with approximately 34 times increased risk of PPH [OR 34.1; 95% CI ((7.1383 – 162.49290, p - <0.0001]. (Table 4).

Table 4 Association of BMI and ASCFT with risk of PPH

	PPH		**Odd Ratio, 95%CI**	**P value**
	Yes (n=13)	**No (n=187)**		
BMI (kg/m²)				
<25	5	165	12 (3.6047 – 39.948)	0.0001
≥25	8	22		
BMI (kg/m²) by ROC				
<24.4	3	172	38.2 (4.2058 – 61.9823)	<0.0001
>24.4	10	15		
ASCFT (mm)				
<15	2	151	23.07 (4.9-108.68)	<0.001
≥15	11	36		
ASCFT (mm) by ROC				
<15.7	2	161	34.1 (7.1383 – 162.49290)	<0.0001
>15.7	11	26		

4. Discussion

Overall prevalence of PPH in our study was 6.5% (13/200) and following vaginal delivery was 2.0% and in LSCS was 4.5%. Prevalence of PPH in our study was lower than prevalence [overall 8.9%, vaginal delivery (5.4%); caesarean section (16.2%)] observed by Fyfe M E et al [21]. In Present study PPH was more common in women with LSCS (69.2%) compared to vaginal delivery (30.8%) which is in contrast with the observation made by Blomberg M [8] and Usha Kiran TS et al[22] where a small increased risk among obese women following vaginal delivery was observed. Polic A et al in their study observed that obese women were more likely to deliver by cesarean section (55.5 vs. 39.8%, $p = 0.016$) and were more likely to have a higher quantitative blood loss and require more units of blood transfusion and had more severe morbidity although they had the same management as those with normal BMI [23].

In present study women who were 25 years or above were 4 times more at risk of having PPH [OR 4.17; 95%CI (1.1134- 15.6679) (p =0.03)]. This was consistent with observation made by Sheen JJ et al [24] and Schmidt L et al [25]. They observed a positive correlation between the advanced maternal age and increased risk of PPH.

In this study PPH was more frequent in overweight and obese women (4.0%) compared with normal BMI (2.5%) which is in line with results of Fyfe M E et al [21], Ettedal A and Aljahdal[26] and Humphrey MD[27]. Amal A. El Badawy et al [28] in their study observed that obese women have an increased risk of PPH (OR= 4.01) regardless of mode of delivery. Bhattacharya S et al in their study observed a linear increase in mean postpartum blood loss with increasing BMI, the risk of postpartum haemorrhage, defined as blood loss of more than 500 ml for vaginal delivery and 1000 ml for caesarean delivery, was significantly higher only in the obese category [29].

The mean SCFT (mm) in women who had PPH was 16.12 ± 2.75 as compared to 12.22 ± 3.00 in women with no PPH. There was significant difference in both the groups. Our results were in contrast to the results of Eley V et al study [20]. In their study there was no significant difference in SCFT in women with and without PPH (16.1 vs 16.0; p = 0.94).

In present study increased BMI was significantly associated with increased risk of developing PPH. BMI at a cut-off value of 25 kg/m^2 was associated with approximately 12 times increased risk of PPH [OR 12; 95% CI (3.6047 – 39.948), P - 0.0001]. The result of present study was consistent with results of Scott-Pillai R et al[30] where an elevated risk of having PPH for women with overweight (RR 1.2, 99% CI 1.0 to 1.4) or obesity (RR 1.3, 99% CI 1.0 to 1.7) was observed. Van Der Linden EL et al [31] in their study observed an elevated risk of having PPH for women with overweight (RR 1.85, 95% CI 0.77-4.43) or obesity (RR 1.78, 95% CI 0.61-5.17). Butwick AJ et al[12] in their study observed that compared to normal body mass index women, the odds of hemorrhage and atonic hemorrhage were modestly increased for overweight women (hemorrhage: 1.06; 99% CI 1.04–1.08); atonic hemorrhage: 1.07; 99% CI 1.05–1.09) and obesity class I (hemorrhage: 1.08; 99% CI 1.05–1.11; atonic hemorrhage; 1.11; 99% CI 1.08–1.15). Vinayagam D in their study observed about 6 times increase risk of PPH in obese women (OR 5.93, 95% CI 2.34–11.98) [11].

In a study examining 1,114,071 Swedish women with singleton pregnancies, the risk of atonic hemorrhage was increased by 14%, 47%, and 114% in women from obesity classes I, II, and III, respectively compared to non-obese women [8]. In a Japanese study of 97, 157 women with singleton pregnancies, obese women had 1.1-fold and 1.9-fold increased risk of postpartum hemorrhage compared to non-obese women after vaginal and cesarean delivery, respectively [32]. Mertens I et al in their study observed that compared to non-obese patients, obese patients have a hypercoagulable state (manifested by higher plasma fibrinogen, factor VII, factor VIII, von Willebrand factor, and plasminogen activator inhibitor levels), which may mitigate the severity of blood loss and the need for transfusion during a major bleed [33].

5. Conclusion

In conclusion, overweight and obese pregnant women are at high risk of PPH. Maternal abdominal subcutaneous fat thickness measured at 16 to 18 weeks of pregnancy by USG is a reliable marker to identify women at risk of PPH in women who does not remember her pre-pregnancy weight. These women require careful antenatal and intranatal care to prevent adverse outcome. Obesity in women is one of the few risk factors which is modifiable so every obese woman should be encourage to reduce weight through diet and life style modifications before planning pregnancy.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

Statement of informed consent

Informed consent was obtained from all women included in the study.

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