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Original Article

Evaluation of the Effectiveness of Modified Early Obstetric Warning System in a Tertiary Health Care Setup

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Abstract

Background: Approximately one-quarter of worldwide maternal deaths occur in India. Early intervention in correct time will result in an improved outcome in high-risk mothers. The Modified Early Obstetric Warning System **(**MEOWS) is a simple bedside screening tool for assessing maternal morbidity. Majority of the studies about MEOWS have come from the UK, where they have found to be a useful method of monitoring and targeting high-risk groups. We have made such an attempt in our institution to formulate and identify the high-risk groups with the usually used bedside and routine blood parameters.

Materials and Methods: This was a prospective study. After obtaining proper informed consent, those women who got admitted as inpatients to the maternity unit with gestation period between 20 weeks to term and followed postpartum up to the period of discharge were included in the study. MEOWS was used as a tool to monitor their well-being.

Results: Our study results revealed that using MEOWS for monitoring pregnant women led to a statistically significant improvement in maternal health care.

Conclusion: Our study has clearly brought out the significance and correlation of various parameters in relation to maternal morbidities. In a developing country like India, identification of high-risk cases with parameters such as blood pressure, heart rate, respiratory rate, temperature, and renal parameters would go a long way in preventing maternal mortality.

Key words: Modified Early Obstetric Warning System, Pregnant Women, Maternal Mortality Prevention

INTRODUCTION

The development of Maternal Early Obstetric Warning System (MEOWS) as a predictor of maternal morbidity from simple bedside observation charts arose from the knowledge that physiological abnormalities precede almost all critical illnesses which lead to maternal mortality. It is thought that early intervention on time will result in an improved outcome in high-risk mothers.[1,2]

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The MEOWS is a simple bedside screening tool for assessing maternal morbidity. Screening identifies the individuals who are likely to have morbidity, while a diagnostic test seeks to confirm its presence definitively.[3] In the UK, there has been a small but welcome decline in maternal death rates against a backdrop of increasing birth rates and an older and less healthy population of mothers.[4,5] However for every maternal death, nine women developed major obstetric complications including hemorrhage, preeclampsia and its complications, sepsis, pulmonary edema, and thromboembolism. A confidential enquiry into the maternal deaths in the UK identified substandard care in a number of cases.[6,7] Many of the avoidable factors such as lack of routine observations and failure to recognize the significance of deteriorating vital signs remained the same as those identified in the previous enquiries. To

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reduce this delay, there have been calls for a "MEOWS" for routine use on all pregnant and postpartum women who have been admitted to hospital and require obstetric care.[8] Use of MEOWS is now included in maternity risk management standards set by the National Health System litigation authority.[9]

MEOWS was introduced to obstetric units in the United Kingdom to decrease maternal mortality by improving early detection by clinical signs of deterioration in women who were developing critical illnesses. Earlier warning scores have been used successfully in other areas, such as acute medicine, however, these scores could not be transferred to obstetric patients because of the normal physiological changes that occur during pregnancy. The MEOWS has been modified for the obstetric population needs to have predictive ability for conditions such as sepsis, hemorrhage, and preeclampsia, and to reflect the physiological changes associated with pregnancy and the early postnatal period.[10]

The existing Joint Commission standardized requirements of hospitals to have a protocol for identifying early warning signs of deterioration by the staffs and to seek assistance if this occurs. A sentinel event alert concerning increasing rates of maternal mortality in the United States recommends that specific changes in maternal vital signs and clinical condition should trigger a predetermined response.[11]

Several early warning tools are currently in use. "In Great Britain, the MEOWS has been proposed and in the United States the National Council for Patient Safety recently proposed the use of the maternal early warning criteria," they write. "Although the use of these tools is widely supported, there are no uniform criteria for inclusion or exclusion of various parameters, what degree of abnormality should be used to measure trigger as more severe or less, mode of treatment as aggressive or less and intervention at what time, and early warning tool was specifically designed to address the four most common causes of maternal morbidity (hemorrhage, preeclampsia, sepsis, and cardiovascular dysfunction). Only the MEOWS has been prospectively tested to evaluate if their use will result in decreased maternal morbidity.[12]" Critical illness in pregnancy is uncommon but potentially a devastating complication of pregnancy.[13] It may be devastating not only for the woman who is sick, but also for her family and for those health-care professionals who are responsible for her care. At its most extreme, critical illness if left unintervened may lead to the death of the woman during pregnancy or shortly afterward. The Confidential Maternal Deaths Enquiry published in 2012 confirmed that Ireland continues to have a low maternal mortality ratio (MMR) by international standards. However, they took efforts to improve the quality of clinical care further in the maternity services continuously.

Critical illness in pregnancy may be due to conditions unique to pregnancy, conditions exacerbated by pregnancy or due to coincidental conditions. This is reflected in the classification of maternal deaths into direct, indirect, and coincidental deaths (CMACE, 2011). The conditions unique to pregnancy include obstetric hemorrhage, preeclampsia/eclampsia, pulmonary embolism (venous and amniotic fluid), chorioamnionitis/endometritis, uterine rupture, placenta accreta, increta, and acute fatty liver of pregnancy.[14]

It has been estimated that for every maternal death, there are around nine women who develop severe maternal morbidity.[15] In a study of severe maternal morbidity for 2004 to 2005 in the three Dublin maternity hospitals, the rate of severe maternal morbidity was 3.2 per 1000 pregnancies.[16] The most common cause was hemorrhage. A national review of postpartum hemorrhage (PPH) in Ireland over 11 years between 1999 and 2009 found that there were increasing rates of atonic PPH.[17]

The MEOWS demonstrated a much higher sensitivity than non-obstetric early warning systems that are currently used in the adult population. MMRs are very high in Asia and Africa compared with North Europe's 4/100,000 live births. An Indian hospital study found the MMR to be 4.21/1000 live births. About 50–98% of maternal deaths are caused by direct obstetric causes (hemorrhage, infection, and hypertensive disorders, ruptured uterus, hepatitis, and anemia). About 50% of maternal deaths due to sepsis are related to illegal induced abortion. MMR in India has not declined significantly in the past 15 years. Age, primi and grand multipara, unplanned pregnancy, and related illegal abortion are the reproductive causes. In 1985, the WHO reported that 63–80% of maternal deaths due to direct obstetric causes and 88–98% of all maternal deaths could probably have been prevented with proper handling. In India, improper coordination between levels in the delivery system and fragmentation of care account for the poor quality of maternal health care.[18]

Gupta *et al.* conducted a study in Rajasthan to ascertain the magnitude of MMR and their causes. The study was conducted in the state of Rajasthan in India, covering

25,926 households in 411 villages. It has two major components: A community-based household survey and a case–control study with cases and controls sampled from the same population. A total of 32 maternal deaths and 6165 live births were identified. The group of women who died during pregnancy or delivery (cases) is compared with a group of women who gave birth and survived (controls). MMR was estimated to be 519 (95% confidence interval [CI], 477–561). Hemorrhage was the chief cause (31%) of maternal deaths; the other causes were obstructed labor, severe anemia, puerperal sepsis, and abortion. Young age at child birth (odds ratio [OR], 2.6; 95% CI, 1.9–3.2) and poverty (OR, 2.5; 95% CI, 1.6–3.4) were independently associated with increased risk of maternal death.[19]

Women in rural India are suffering primarily because of the inability of the people managing in rural health centers to recognize clinical symptoms in time, resulting in their failure to diagnose and delayed referral to a higher center contributes to majority of the maternal deaths. For every woman in India who die due to pregnancy-related complications, there are 20 who suffer from acute and chronic morbidity, some of them are life threatening.

Aims and Objectives

This study aims to evaluate the MEOWS as a tool for predicting maternal morbidity by measuring its sensitivity, specificity, and predictive value for various parameters which are used to assess various maternal morbidities diagnosed during this study period. This is to provide guidance to the healthcare personnel who are involved in the maternity services on recognizing and monitoring the obstetric patients using the MEOWS chart. This will enable early recognition of patient deterioration; advice on the level of monitoring required by each patient, facilitate better communication within the multidisciplinary team, and ensure prompt management of any women whose condition is deteriorating.

MATERIALS AND METHODS

This study is a prospective study carried out from November 2014 to April 2016 at K.A.P.V Medical College and M.G.M Government Hospital, Trichy, after getting approval from the Institutional Ethical Committee. Over a period of 9 months, 1000 parturient women, all women with gestation between 20 weeks to term were included in the study. They were admitted as inpatients to the maternity unit and followed up postpartum up to the period of discharge. All patients fulfilling the inclusion criteria were explained about the type of study and written informed consent was obtained.

Inclusion Criteria

The following subjects were enrolled for the study:

Women aged between 18 and 40 years, having gestational age from 20 weeks till term, were followed postnatal up to discharge. Pregnant women were enrolled irrespective of any gravida, any presentation, and single/multiple gestation.

Exclusion Criteria

Patients who were already diagnosed and treated with the following diseases/disorders were excluded from the study: Anemia, preeclampsia, chronic hypertension, overt diabetes mellitus, chronic medical disease, and thyroid dysfunctions.

Measurement of temperature (oral), blood pressure, heart rate (HR), respiratory rate (RR), oxygen saturation (pulse oximetry), conscious level, and pain score were documented every 12 h. Frequency of observations is determined by risk status, diagnosis, reason for admission, and initial observations on admission. An individual plan of care which specified the frequency of physiological observations was decided by the doctor.

The MEOWS has been designed to allow early recognition of deterioration in parturient women by monitoring variation in their physiological parameters. MEOWS is a way of formal measurement of physiological variables. The values of the observations are then translated into a summary score which has a critical threshold, above which medical review and intervention are required.

Guidelines for the Use of MEOWS in Detecting the Seriously Ill and Deteriorating Woman

Effective warning systems include clear expectations for observation, predefined criteria for an abnormality, and a protocol to trigger a response if an abnormality is detected.[20] The MEOWS was calculated by scoring the values of a full set of observations carried out routinely by staff which included the following:

i). Temperature ------ <35°C or >37.4°C[21]
ii). Systolic blood pressure (SBP) ----- <90 or >140 mmHg[22]
iii). Diastolic blood pressure (DBP)-------- <46 or>90 mmHg
iv). HR------- <51 or>100[23]
v). RR ------- <9 or >14
vi). Level of consciousness using AVPU scale
    A – Alert and conscious
    V – Responds to voice
    P – Pain responds to pain
    U – Unresponsive no response to voice or pain
vii). +/- urine output ------ <30 ml/ 2 h
viii). Oxygen saturation ----- <95%.

MEOWS Scoring

Score	3	2	1	0	1	2	3
Tempe rature		<35°c		35°-37.4°c		37.5-39°c	>39°c
Systolic BP	≤70	71-79	81-89	90-139	140-149	150-159	≥160
Diastolic BP			≤45	46-89	90-99	100-109	≥110
Pulse		≤40	40-50	51-100	101-110	111-129	≥130
Respiratory rate		≤8		9-14	15-20	21-29	≥30
APVU				alert	Responds to voice	Responds to pain	unconsc ious
U/O ml per hour	<10	<30		Not measured			

Triggering on MEOWS chart

A trigger was defined as a single markedly abnormal observation (red trigger) or a combination of two simultaneous mildly abnormal observations (two yellow triggers).

PARAMETER	RED TRIGGER	YELLOW TRIGGER
TEMPERATURE	< 35 or > 38	35–36
SYSTOLIC BP	<90 or>160	150-160 or 90-100
DIASTOLIC BP	>100	90-100
HEART RATE	<40 OR>120	100-120 OR 40-50
RESPIRATORY RATE	<10 OR >30	21-30
O2 SAT	<95	
NEUROLOGICAL SCORE	UNRESP,PAIN	VOICE

The examined subjects were classified into two groups: Those who triggered and those who did not trigger. A trigger is set to prompt urgent medical attention.

Any patient is said to have developed a trigger if she fulfills any of the criteria mentioned below: Hypertension (SBP >160 or DBP >100), hypotension (SBP <90), tachycardia (HR >120), bradycardia (HR <50), tachypnea (RR >30), bradypnea (RR <10), hypoxemia (SpO_2 <95% on room air), oliguria (<30 cc/h for >2 h), confusion, agitation, or unresponsiveness.

OBSERVATION AND RESULTS

Table 1 shows that primigravida formed the bulk (51.4%) of the cases while the multigravida formed the remaining cases. This is depicted in Figure 1.

Table 2 shows that out of 1000 cases examined, 131 cases triggered for parameter of tachycardia and the remaining 869 did not trigger for the same. This is depicted in Figure 2.

Table 3 shows that out of the 1000 cases, 14.7% of the cases triggered for increase in blood pressure and diagnosed hypertensive and the rest 85.3% did not trigger and remained normotensive is shown in Figure 3.

Table 1: Gravida status

	Frequency	Percent
PRIMI	514	51.4
MULTIGRAVIDA	486	48.6
Total	1000	100.0

Table 2: Heart rate

	Frequency	Percent
INCREASED	131	13.1
NORMAL	869	86.9
Total	1000	100.0

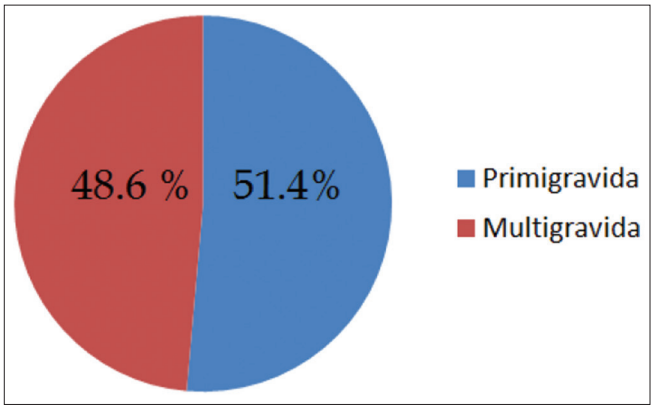

Figure 1: Gravida status

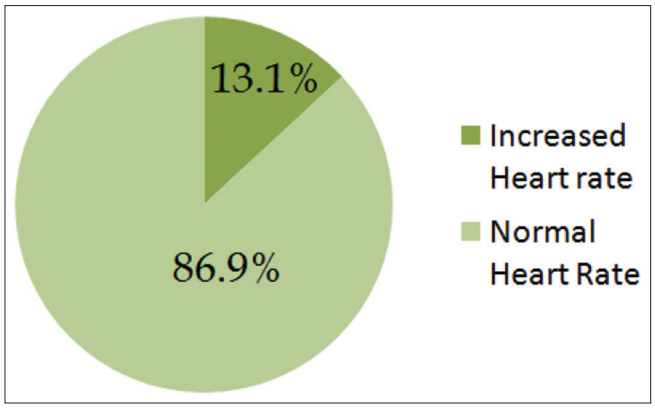

Figure 2: Heart rate

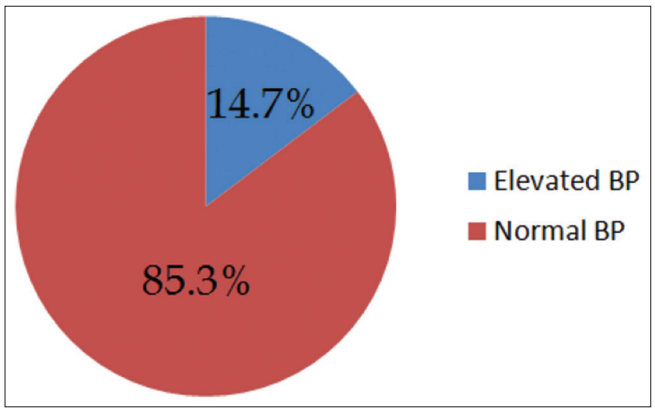

Figure 3: Blood pressure

Table 4 shows that of all the cases examined in the study, only six cases showed elevated renal parameters while 994 cases had normal renal parameters. This is depicted in Figure 4.

Table 5 shows that there was trigger for elevation in temperature in only nine cases that were studied. Remaining 991 cases had normal body temperature as shown in Figure 5.

Table 6 shows that out of the 1000 cases examined in the study, 23 cases showed the trigger for tachypnea while the remaining 977 cases recorded normal RR. This is depicted in Figure 6.

Table 7 shows the neurological score of the examined cases. About 98% of cases were neurologically normal and <2% of cases were found to have neurological instability. This is depicted in Figure 7.

Table 8 shows the magnitude of increase in the triggering parameters noted in the study. Of the 1000 cases examined, 796 cases showed normal parameters. Eighty-two cases showed only elevated blood pressure, 53 cases showed tachycardia, 5% (48) of cases showed elevation of both blood pressure and pulse rate, two cases showed abnormal

Table 3: Blood pressure

	Frequency	Percent
INCREASED	147	14.7
NORMAL	853	85.3
Total	1000	100.0

Table 4: Renal function tests

	Frequency	Percent
INCREASED	6	0.6%
NORMAL	994	99.4%
Total	1000	100.0

Table 5: Temperature

	Frequency	Percent
INCREASED	9	0.9%
NORMAL	991	99.1%
Total	1000	100.0

renal parameters, abnormal blood pressure, abnormal HR, and abnormal RR, two cases showed abnormal renal

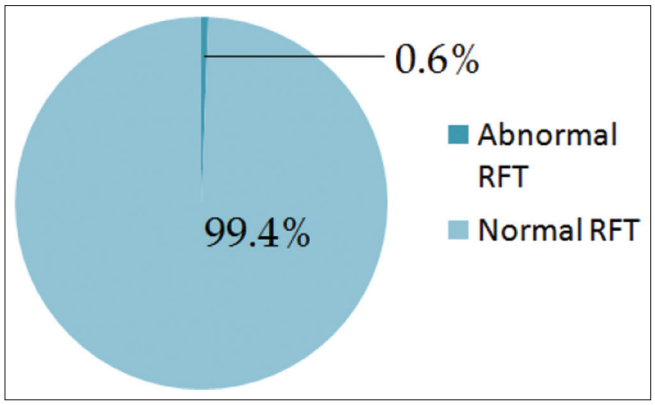

Figure 4: Renal function tests

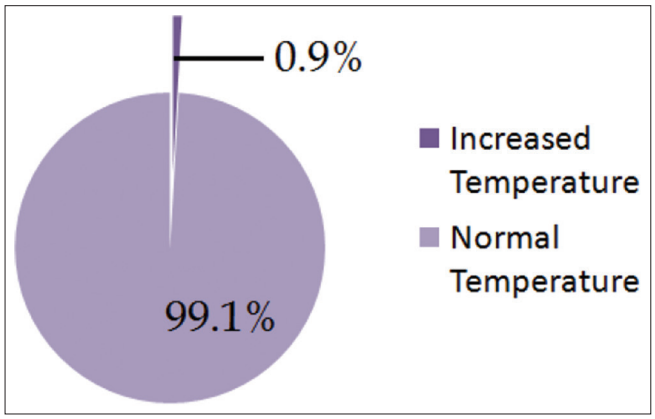

Figure 5: Temperature

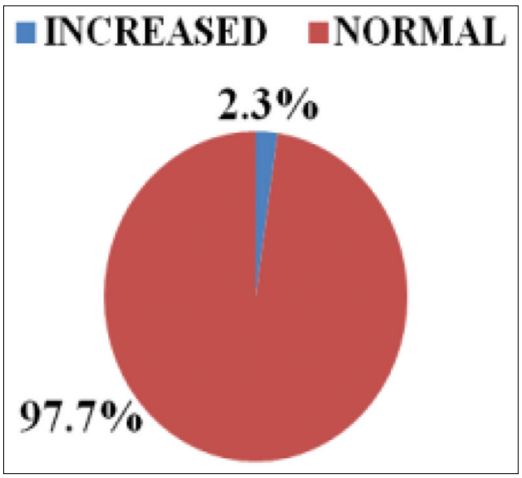

Figure 6: Respiratory rate

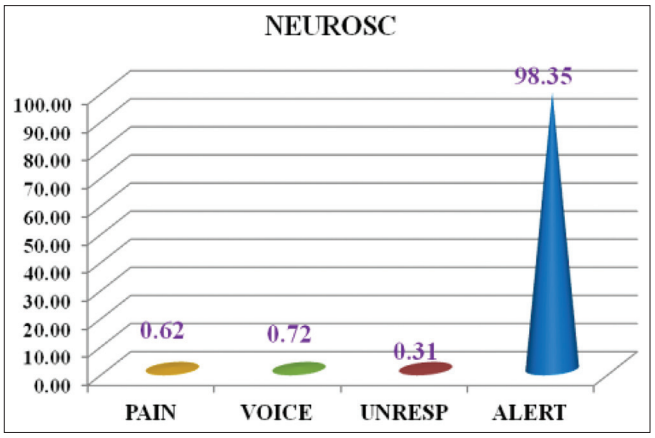

Figure 7: Neurological score

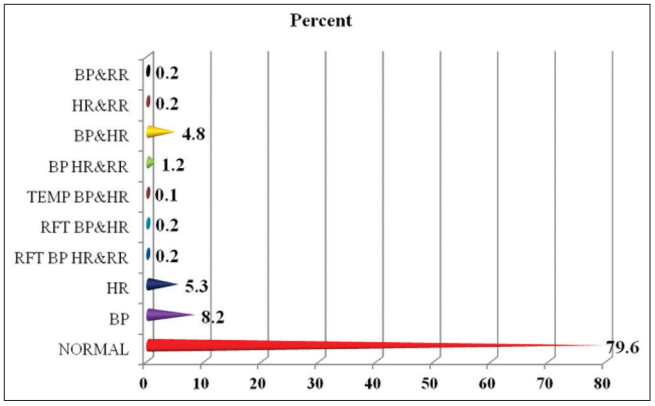

Figure 8: Triggering parameters and normal parameters

Table 6: Respiratory rate

	Frequency	Percent
INCREASED	23	2.3
NORMAL	977	97.7
Total	1000	100.0

parameters, abnormal blood pressure, and abnormal HR, two cases showed abnormal blood pressure and abnormal RR, and two cases showed abnormal blood pressure and abnormal RR. Twelve cases showed elevation of blood pressure, HR, and RR. Only one case showed elevated temperature, abnormal blood pressure, and abnormal HR. This is depicted in Figure 8.

Table 9 shows the spectrum of morbidities seen in the study. Of the 1000 cases examined, 96 cases were preeclamptic, 45 cases had PPH, 19 cases had PPH with preeclampsia, 15 cases were found to have eclampsia, and 2 of these cases with eclampsia developed cortical venous thrombosis (CVT). Wound infection was found in nine cases, three cases had pulmonary edema, and pulmonary thromboembolism was found in one case. This is depicted in Figure 9.

Table 10 shows the exact number of cases that had abnormal elevation of blood pressure with relation to

Table 7: Neurological score

NEUROLOGICAL SCORE	COUNT	PERCENT
PAIN	6	0.62
VOICE	7	0.72
UNRESPONSIVE	3	0.31
ALERT	984	98.35
TOTAL	1000	100

the morbidities recorded. Of the 45 cases recorded with PPH, only three cases had hypertension. Out 0f 96 cases with preeclampsia, 90 cases had elevated blood pressure. Of the 19 cases that had preeclampsia with PPH, 18 cases had hypertension. The correlation of blood pressure to various morbidities was found to be statistically significant.

Table 11 shows the exact number of cases that had abnormal HR in relation to the morbidities. Of 45 cases of PPH, 34 cases showed the trigger of tachycardia, of 96 cases of preeclampsia, 23 cases showed this trigger, of 19 cases of PPH with preeclampsia, 16 cases had the trigger, of nine cases of wound infection, five cases had the trigger, of 15 cases of eclampsia, 13 cases had the trigger, both cases of CVT had the trigger, all the cases of pulmonary edema and embolism had the trigger of tachycardia. The correlation of HR to various morbidities was found to be statistically significant.

Table 12 shows the relation of RR to various morbidities recorded in the study. Tachypnea was present in all cases of pulmonary edema and pulmonary thromboembolism. The correlation of RR with all morbidities was found to be statistically significant.

Table 13 shows the correlation of renal function tests and temperature in relation to the morbidities along with various other parameters such as blood pressure, HR, and RR in relation to the morbidities included in the study. Abnormalities in blood pressure, HR, and combination of both were sensitive in diagnosing morbidities. Other parameters such as RR and temperature too were sensitive in diagnosing morbidities. The correlation of these various parameters in relation to morbidities was found to be statistically significant.

Table 8: Triggering parameters and normal parameters

	Frequency	Percent
NORMAL	796	79.6
BP	82	8.2
HR	53	5.3
RFT BP HR&RR	2	.2
RFT BP&HR	2	.2
TEMP BP&HR	1	.1
BP HR&RR	12	1.2
BP&HR	48	4.8
HR&RR	2	.2
BP&RR	2	.2
Total	1000	100.0

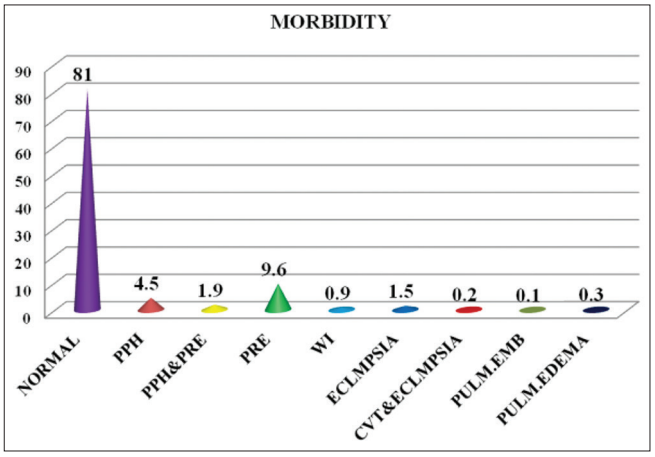

Figure 9: Morbidity spectrum

Table 9: Morbidity spectrum

MORBIDITY		
	Frequency	**Percent**
NORMAL	810	81.0
PPH	45	4.5
PPH&PRE	19	1.9
PRE	96	9.6
WI	9	.9
ECLAMPSIA	15	1.5
CVT&ECLAMPSIA	2	.2
PULM.EMB	1	.1
PULM.EDEMA	3	.3
Total	1000	100.0

Table 10: Correlation of blood pressure in relation to the morbidities

		MORBIDITY									Total	Sig
		NORMAL	PPH	PPH & PRE	PRE	WI	ECLAMPSIA	CVT&ECLAMPSIA	PULM. EMB	PULM. EDEMA		
BP	INCREASED	14	3	18	90	1	15	2	1	3	147	P=.000 Sig
		1.4%	.3%	1.8%	9.0%	.1%	1.5%	.2%	.1%	.3%	14.7%	
	NORMAL	796	42	1	6	8	0	0	0	0	853	
		79.6%	4.2%	.1%	.6%	.8%	.0%	.0%	.0%	.0%	85.3%	
Total		810	45	19	96	9	15	2	1	3	1000	
		81.0%	4.5%	1.9%	9.6%	.9%	1.5%	.2%	.1%	.3%	100.0%	

Table 14 shows the occurrence of morbidities in relation to primigravida and multigravida women. Our study has shown that there is no statistical significance in the morbidities in relation to primi or multigravida women.

Table 11: Correlation of heart rate in relation to the morbidities

		MORBIDITY									Total	Sig
		NORMAL	PPH	PPH& PRE	PRE	WI	ECLAMPSIA	CVT& ECLAMPSIA	PULM. EMB	PULM. EDEMA		
HR	INCREASED	34	34	16	23	5	13	2	1	3	131	P=.000 Sig
		3.4%	3.4%	1.6%	2.3%	.5%	1.3%	.2%	.1%	.3%	13.1%	
	NORMAL	776	11	3	73	4	2	0	0	0	869	
		77.6%	1.1%	.3%	7.3%	.4%	.2%	.0%	.0%	.0%	86.9%	
Total		810	45	19	96	9	15	2	1	3	1000	
		81.0%	4.5%	1.9%	9.6%	.9%	1.5%	.2%	.1%	.3%	100.0%	

Table 12: Correlation of respiratory rate in relation to the morbidities

		MORBIDITY									Total	Sig
		NORMAL	PPH	PPH& PRE	PRE	WI	ECLAMPSIA	CVT&ECLAMPSIA	PULM .EMB	PULM. EDEMA		
RR	INCREASED	4	3	2	3	2	4	1	1	3	23	P=.001 Sig
		.4%	.3%	.2%	.3%	.2%	.4%	.1%	.1%	.3%	2.3%	
	NORMAL	806	42	17	93	7	11	1	0	0	977	
		80.6%	4.2%	1.7%	9.3%	.7%	1.1%	.1%	.0%	.0%	97.7%	
Total		810	45	19	96	9	15	2	1	3	1000	
		81.0%	4.5%	1.9%	9.6%	.9%	1.5%	.2%	.1%	.3%	100.0%	

Table 15 shows the diagnostic accuracy values of various parameters included in the study. Blood pressure was found to have highest sensitivity and specificity in relation to the morbidities recorded in our study. HR showed next highest specificity in picking up morbidity. Renal function tests and RRs showed next highest sensitivity in diagnosing morbidities. Blood pressure showed the highest positive predictive value and diagnostic accuracy followed by HR. Negative predictive value was highest with renal function test followed by RR and temperature.

DISCUSSION

Thousand consecutive antenatal cases who got admitted at K.A.P.V Government Medical College in the Department of Obstetrics were examined in a systematic way and findings were recorded. The aim of our study was to clinically evaluate these antenatal women by recording their HR, blood pressure, RR, oxygen saturation (SPO_2), and temperature along with neurological and pain scoring.

Table 13: Correlation of renal function tests and temperature in relation to the morbidities

		NORMAL	PPH	PPH&PRE	PRE	WI	ECLAMPSIA	CVT& ECLAMPSIA	PULM. EMB	PULM. EDEMA	TOTAL	SIGNIFICANCE
co	NORMAL	751	15	2	22	3	3	0	0	0	796	
		75.1%	1.5%	.2%	2.2%	.3%	.3%	.0%	.0%	.0%	79.6%	
	BP	20	11	6	36	4	4	0	0	1	82	
		2.0%	1.1%	.6%	3.6%	.4%	.4%	.0%	.0%	.1%	8.2%	
	HR	27	11	0	14	1	0	0	0	0	53	
		2.7%	1.1%	.0%	1.4%	.1%	.0%	.0%	.0%	.0%	5.3%	
	RFT BP HR&RR	0	0	0	2	0	0	0	0	0	2	
		.0%	.0%	.0%	.2%	.0%	.0%	.0%	.0%	.0%	.2%	
	RFT BP&HR	0	0	0	1	0	1	0	0	0	2	
		.0%	.0%	.0%	.1%	.0%	.1%	.0%	.0%	.0%	.2%	
	TEMP&HR	1	0	0	0	0	0	0	0	0	1	P=0.001
		.1%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.1%	Sig
	BP HR&RR	4	3	1	0	0	2	0	1	1	12	
		.4%	.3%	.1%	.0%	.0%	.2%	.0%	.1%	.1%	1.2%	
	BP&HR	6	5	8	20	1	5	2	0	1	48	
		.6%	.5%	.8%	2.0%	.1%	.5%	.2%	.0%	.1%	4.8%	
	HR&RR	1	0	0	1	0	0	0	0	0	2	
		.1%	.0%	.0%	.1%	.0%	.0%	.0%	.0%	.0%	.2%	
	BP&RR	0	0	2	0	0	0	0	0	0	2	
		.0%	.0%	.2%	.0%	.0%	.0%	.0%	.0%	.0%	.2%	
	Total	810	45	19	96	9	15	2	1	3	1000	
		81.0%	4.5%	1.9%	9.6%	.9%	1.5%	.2%	.1%	.3%	100.0%	

These women were allowed to undergo natural course of treatment in the hospital. Their mode of delivery (normal/LSCS) was decided by a competent authority. The morbidities were recorded in an unbiased manner.

Table 14: Occurrence of morbidities in relation to gravida status

		MORBIDITY									Total	Sig
		NORMAL	PPH	PPH&PRE	PRE	WI	ECLAMPSIA	CVT&ECLAMPSIA	PULM.EMB	PULM.EDEMA		
OBS CODE	PRIMI	417	21	7	54	2	10	1	1	1	514	
		41.7%	2.1%	.7%	5.4%	.2%	1.0%	.1%	.1%	.1%	51.4%	
	MULTIGRAVIDA	393	24	12	42	7	5	1	0	2	486	P=.366
		39.3%	2.4%	1.2%	4.2%	.7%	.5%	.1%	.0%	.2%	48.6%	Non Sig
Total		810	45	19	96	9	15	2	1	3	1000	
		81.0%	4.5%	1.9%	9.6%	.9%	1.5%	.2%	.1%	.3%	100.0%	

Table 15: Diagnostic accuracy values of various parameters

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy
RFT	83%	81.39%	2.63%	99.88%	81.4%
TEMP	55.56%	81.33%	2.63%	99.51%	81.1%
BP	90.48%	93.32%	70%	98.27%	92.9%
HR	74.05%	89.3%	51.05%	95.8%	87.3%
RR	82.61%	82.5%	10%	99.51%	82.5%

Of the 1000 cases enrolled in the study, 514 cases were primigravida and the remaining 486 were multigravida. These multigravida mothers ranged from the second to sixth gravida. For our convenience, we have grouped them together as multigravida. Although the incidence of morbidities such as PPH and PPH with preeclampsia was higher in multigravida, *per se* PPH was most common among grand multigravidae, preeclampsia seems to be more common among very young individuals <21 years, and in multies who had last child birth >5 years and above. Eclampsia was found more often in primi, various other morbidities such as CVT, pulmonary edema, and pulmonary embolism were equal among both. No statistical significance was made out.

Of the 1000 cases that were examined, 131 cases showed the trigger of tachycardia, HR had sensitivity of 74%, specificity of 89%, PPV of 51%, NPV of 95.8%, and diagnostic accuracy of 87.3%.

One hundred and forty-seven women had trigger of elevation of blood pressure. Blood pressure as predictor of morbidity had the sensitivity of 90.5%, specificity of 93.3%, PPV of 70%, NPV of 98.3%, and diagnostic accuracy of 93%.

About 23 cases showed trigger of tachypnea. RR as a predictor of morbidity had sensitivity of 82.6%, specificity of 82.5%, PPV 10%, NPV of 99.5%, and diagnostic accuracy of 82.5%. Only nine women showed trigger of hyperthermia, as a predictor of morbidity, it had sensitivity of 55.6%, specificity of 81.3%, PPV of 2.6%, NPV of 99.5%, and diagnostic accuracy of 81%.

Neurological score was found to be abnormal only in <2% of cases, particularly in cases with eclampsia and CVT. Pain score was found to be normal in 98% of cases and abnormal in <1%.

Of the 1000 cases studied, 810 cases delivered and got discharged normally. Ninety-six cases developed preeclampsia while 45 cases developed PPH and 19 cases had both preeclampsia and PPH. About 15 cases developed eclampsia and two out of these 15 eclamptic cases developed CVT with neurological deficit. Nine cases developed wound infection and three cases developed pulmonary edema, all the three were preeclamptic. With MEOWS, we were able to identify these cases at the right time manage correctly and one case was found to have pulmonary thromboembolism, with timely intervention we are able to resuscitate the case promptly.

The data analysis shows that nearly one-fifth (190) of the cases enrolled in the study developed complications. Of these cases that developed complications, nearly >50% of them were preeclamptic. One-fourth of them had developed PPH.

Relationship of Parameters with Morbidity

The analysis of data further shows that 133 cases out of 147 that had elevated blood pressure developed complications, 97 cases out of 131 that had tachycardia developed complications. About 19 cases out of 23 cases that had elevation of RR developed complications. About five cases out of nine that had elevated temperature had developed complications and five cases out of six who had elevated renal parameters developed complications.

Relationship of Mode of Delivery and Morbidity

Out of 613 cases that underwent normal delivery, 75 cases developed morbidity. Of the 387 cases that had undergone LSCS as mode of delivery, 115 cases developed morbidity. There was a statistical significance of correlation in patients undergoing LSCS as a mode

of delivery developing complications when compared to normal delivery cases. Out of the 514 cases of primi, 97 cases developed morbidity, of the 486 multiparous cases, 93 cases developed morbidity. In our study, there was no significant difference in morbidity between multiparous and nulliparous women.

Parameters Analysis

Blood pressure has the highest sensitivity and specificity in detecting morbidities (90% and 93%, respectively). HR comes second and has a sensitivity and specificity of 74% and 89%. Renal function tests and RR had a sensitivity and specificity of 82%. Temperature had sensitivity and specificity of 55% and 81%, respectively, whereas RR had sensitivity and specificity of 82.6% and 82.5%, respectively.

The positive predictive value was highest with blood pressure 70% followed by HR 51%. The negative predictive value was found to be almost equal in all parameters. Diagnostic accuracy was found to be highest with blood pressure (93%) followed by HR (87%).

CONCLUSION

The MEOWS is a simple bedside screening tool for assessing maternal morbidity. Screening identifies individuals who are likely to have morbidity, while a diagnostic test confirms its presence definitively. We attributed to use morbidity as our primary end point, rather than death because of its rare occurrences in obstetric patients. In MEOWS, we applied the early signs of morbidity that was recognized as triggering criteria. In our hospital, every obstetric patient has a MEOWS chart started at the first visit and vital signs documented until discharge. The chart stays with the mother until postnatal discharge. This provides a visual trend of individual physiology and allows assessment and treatment based on what is abnormal for the patient, not for the population as a whole. There are some drawbacks to our study. The triggers that we used were set close to the values that define morbidity. Thus, a positive trigger, for example, high blood pressure, which is associated with morbidity, often becomes a self-fulfilling prophecy. This is a single-center based study in a tertiary referral center. Our definitions of morbidity have been incorporated from nationally accepted diagnostic criteria as far as possible, but there is no universal definition for obstetric morbidity, some of these definitions are slightly arbitrary, which will influence whether a woman enters the "morbidity" group or not. Despite these limitations, our results strongly support the use of the MEOWS chart for all obstetric patients.

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