Dr. Mileva Grace Chacko
Senior Resident, Department of
Obstetrics & Gynaecology, ESIC
Model & Super Specialty Hospital,
Ashramam, Kollam, Kerala, India

Dr. Geetha Madahavanpillai Indira
Retired Associate Professor,
Department of Obstetrics &
Gynaecology, Government Medical
College, Trivandrum, Kerala, India

Dr. Geethanjali Syamala Mohan
Assistant Professor, Department of
Obstetrics & Gynaecology, SAT,
Government Medical College,
Trivandrum, Kerala, India

Dr. Mayadevi Brahmanandan⁴
Assistant Professor, Department of
Obstetrics & Gynaecology, SAT,
Government Medical College,
Trivandrum, Kerala, India

Clinical and epidemiological profile of maternal near miss in a tertiary care centre

Mileva Grace Chacko, Geetha Madahavanpillai Indira, Geethanjali Syamala Mohan and Mayadevi Brahmanandan

Abstract
Background: Despite therapeutic advances during this century and growing perception of the safety of child birth, morbidity and mortality continue to occur in obstetric patients. Maternal mortality was considered the critical indicator to assess the quality of services provided by a health care system. Maternal mortality is just the tip of iceberg where maternal morbidity remains largely undescribed. Maternal near miss fill this gap. Maternal near miss is defined as women who survives life threatening condition during pregnancy abortion and child birth or within 42 days of pregnancy termination, irrespective of receiving emergency medical or surgical intervention. Maternal near miss are more common than maternal death and studying maternal near miss cases can become a useful tool to design the strategies to improve the maternal outcome. Thus, near miss is a leading indicator to maternal mortality that, if scrutinized and used correctly, can prevent both mortality and severe morbidity.
Objectives: To study the clinical and epidemiological profile of maternal near miss in a tertiary care centre.
Methods: A retrospective case sheet based descriptive study was conducted in the department of obstetrics and gynaecology, government medical college, Thiruvananthapuram. All maternal near miss cases admitted in the department during 2019 may 1st to 2020 April 30th were included in the study. The data was extracted from the near miss register kept in the department and inpatient register kept in medical records. The information on the sociodemographic characteristics of the women like age parity educational status place of residence occupation and obstetric and medical history such as mode of delivery complication during pregnancy other comorbidities were collected and entered into proforma. All these data were then entered into excel sheet and analysis was done using statistical software SPSS v26.0.
Results: It was found that haemorrhage was the leading cause of maternal near miss constituting about 57.14% of cases. Of which atonic PPH was the most common cause of PPH 35.71%. There is an alarming increase in number of adherent placenta which constitute about 32.1% of cases. 44.8% of PPH needed obstetric hysterectomy. Sepsis constituted the next largest group accounting for 17.24% of maternal near miss, followed by hypertensive disorders of pregnancy.
Conclusion: The most common cause of maternal near miss was haemorrhage in which atonic PPH accounts for the majority of near miss. Adherent placenta constituted 32.1% of haemorrhage. sepsis and hypertensive disorder of pregnancy were found to be the next major causes.

Keywords: Maternal near miss, maternal mortality, pregnancy, haemorrhage, sepsis, hypertension

Introduction

Maternal near miss audit is a relatively new concept but getting rapidly accepted as equal to or better than death audit in improving maternity care and preventing maternal death. The concept of near miss audit is a way forward to avoid maternal death and bring down the maternal mortality ratio. Maternal mortality remains an ongoing concern even though significant improvement has occurred in recent years. To reduce MMR further, we should plan strategies based on the real circumstances that lead to maternal death. An alternative approach can be to audit near miss cases. For each maternal death that occurs there are several other who go through serious life-threatening situation and survive.

Maternal mortality refers to death due to complications from pregnancy or childbirth. From 2000 to 2017, the global maternal mortality ratio declined by 38 per cent - from 342 deaths to 211 deaths per 100,000 live births, according to UN. This is less than half the 6.4 per cent annual rate needed to achieve the Sustainable Development global goal of 70 maternal deaths per 100,000 live births [1].

Corresponding Author:
Dr. Geethanjali Syamala Mohan
Assistant Professor, Department of
Obstetrics & Gynaecology, SAT,
Government Medical College,
Trivandrum, Kerala, India

A woman who survives life threatening condition during pregnancy, abortion, and child birth or within 42 days of pregnancy termination, irrespective of receiving emergency medical/surgical intervention, is called maternal near miss [2].

Women who survive life-threatening conditions arising from complications related to pregnancy and childbirth have many common aspects with those who die of such complications. This similarity led to the development of the near-miss concept in maternal health. Exploring the similarities, the differences and the relationship between women who died and those who survived life-threatening conditions provide a more complete assessment of quality in maternal health care.

As the complication during pregnancy and child birth often occur unexpectedly, timely access to emergency care is often the deciding factor in saving the lives. Aware ness and early identification of high-risk factor, recognition of early warning signs protocol in place for prompt and timely intervention will help us improve both maternal and perinatal outcomes essential

infrastructure, resources and equipment are also crucial in defining the outcome.

As significant number of near miss cases are significantly more than maternal death, a larger number of cases are available for a reliable analysis. Interviewing these women who survived the complication may be less threatening to the health care providers. The details of the sequence of events and other contributory factors may be more forthcoming. Associated factors that helped the women survive can be analysed. These reviews enable us to advantageously modify and implement strategies and have protocols in place which will help to reduce the severity of such complication and prevent maternal deaths.

Causes of maternal near miss mortality can be divided in to 2 broad categories [2].

1. Direct causes → pregnancy specific obstetric cand medical disorders
2. Indirect causes → pre-existing disorders aggravated during pregnancy → incidental and accidental causes in pregnancy

Pregnancy specific obstetric and medical disorders	Pre-existing disorders aggravated during pregnancy	Incidental and accidental causes in pregnancy
Haemorrhage Hypertension Postpartum collapse Liver dysfunction Cardiac dysfunction	Anaemia Respiratory dysfunction Cardiac dysfunction Hepatic dysfunction Endocrine disorders: diabetic ketoacidosis thyroid crisis Neurological dysfunction Renal dysfunction /failure	Accident/assault /surgical problem Anaphylaxis infection Embolism and infarction

According to WHO the primary goal is to eliminate preventable maternal death. In the context of the Sustainable Development Goals (SDG), countries have united behind a new target to accelerate the decline of maternal mortality by 2030. SDG 3 includes an ambitious target: "reducing the global MMR to less than 70 per 100 000 births, with no country having a maternal mortality rate of more than twice the global average" [3]. A technical working group of obstetricians, midwives epidemiologist and public health care professionals was established by the WHO IN 2002 to develop a standard definition and uniform identification criteria for maternal near miss cases. Maternal near miss reviews are now being conducted in several countries. In United Kingdom, the MBRRACE report evaluate the reason for maternal morbidity and ways to reduce them. According to MBRRACE -UK reports [4] 2017 -19,191 women died during or up to 6 weeks after the end of pregnancy among 2173810 women giving birth in the UK.8.8 women per 100000 died during pregnancy or up to 6 weeks after child birth or the end of pregnancy there is no statistically significant difference in maternal mortality compared to 2010-12.17% of women died had good care. Cardiac disease remains the largest single cause of maternal death. Neurological causes are the second most common cause of maternal death in United Kingdom. Thrombosis and thromboembolism remain the leading cause of direct maternal death during or up to six weeks after the end of pregnancy maternal suicide remains the leading cause of direct death occurring within a year after the end of pregnancy [5].

Maternal Mortality Ratio(MMR) of India for the period 2016-18, as per the latest report of the national Sample Registration system (SRS) data is 113/100,000 live births [1].

All women need access to antenatal care in pregnancy, skilled care during childbirth, and care and support in the weeks after

childbirth. All births should be assisted by skilled health professionals, as timely management and treatment can make the difference between life and death for both the mother and the baby. The Government of India has been focusing on initiatives to improve maternal health indicators. Much progress has been made in ending preventable maternal deaths in the past two decades. In India, the maternal health division, ministry of health and family welfare, government of India, in 2014 published "the operational guidelines for maternal near miss review" to be implemented by all states in the country. The main aim being to be able to analyse the performance of the health care system, identify the gaps and implement appropriate corrective measures. However, coverage of life-saving health interventions and practices remains low due to gaps in knowledge, policies and availability of resources. In a few areas there is a gap between the rich and the poor and an urban and rural divide. Access to health services is often dependent on a families' or mother's economic status and where they reside. Kerala's health indicators have been consistently better than the national Indian average, due to high literacy, better road networks and a large number of health facilities. However, the maternal mortality ratio MMR in Kerala has remained almost static in the last couple of decades. According to the sample registration system in Kerala MMR was 46 during 2012 and 43 in 2018.

Near miss review in Kerala
In 2017, KFOG initiated a pilot study of maternal near miss cases in five government medical colleges in Kerala. Operational guidelines 2104 by government of India was followed. After 2 years of this pilot project district level MDNMSR was constituted in all the district of the state. All delivery point identified and a monthly report of MNM cases is being reported.

MNM category	Number of cases	Percentage
Category 1: Pregnancy specific obstetric and medical disorder	324	88.7
Category 2: Pre-existing disorders aggravated during pregnancy	24	6.6
Category 3: Accidental or incidental disorders in pregnancy	17	4.7

In the review haemorrhage constituted 65.7% of cases which was the most common cause of near miss in kerala.it was followed by sepsis 16.4% and hypertensive complications 13%. Of the haemorrhagic complication placenta previa accrete constituted 35.68% of cases Neurological causes were the most common pre-existing disorder that was aggravated during pregnancy followed by cardiac and respiratory disease. Infection was the major cause of near miss in category 3 i.e., accidental /incidental disorders in pregnancy. Another study in Kerala has showed haemorrhage is the most common cause of near miss in Kerala followed by hypertension and sepsis [4].

Significant contributory factors to near miss
- Poor antenatal care
- Failure or delay in recognizing a potentially life-threatening condition
- Delay in referral and other social factors
- Lack of adherence to standard protocols
- Limitation of resources
- Poor documentation of events that occurred

But it is worth mentioning at the same time that these women were saved most often because of prompt and timely interventions like early referrals, excellent multidisciplinary team management thus avoiding a potential mortality.
The major causes in maternal near miss obtained from various studies worldwide were
1. Haemorrhage
2. Hypertensive disorders
3. Sepsis

Materials and Methods
Study Methods: Near miss cases were identified using government of India's Maternal near miss criteria.

Study design: retrospective case sheet based observational study

Study setting: High dependency unit of labour room stage 2 and maternal intensive therapy unit Sree Avitom Thirunal Hospital Thiruvananthapuram

Study population: All maternal near miss cases admitted to the high dependency unit of labour room stage 2 and MITU, SATH, medical college Thiruvananthapuram from 1st may 2109 to 30th April 2020

Study Period: 1 year from the date of institutional ethics committee clearance.

Ethical considerations: Permissions from the medical records library was sought for case record retrieval. Prior approval was obtained from the institutional ethics committee. Being a retrospective study, these merits waiving of consent. All data collected are kept strictly confidential. HEC NUMBER:01/18/2021/MCT
Information was collected from case records of these patients after approval by Human ethics committee, GMCT. Important aspects of case history like age, obstetric score, this is a retrospective study based on secondary data analysis. No interventions were done on the participants.

Inclusion criteria
Clinically ill pregnant, labouring, post-partum and post abortal women admitted to the HDU side of labour room and MITU Sree Avittom Thirunal Hospital TVM.Criteria for identifying and notifying the MNM case: minimum 3 from each category must be met with:
1. Clinical findings either symptoms or signs
2. Investigation
3. Intervention. Or any single criteria which signifies cardio respiratory collapse indicated by heart symbol

Exclusion criteria
Those cases which does not come under the criteria for near miss.

Results
Total number of maternal near miss at SATH during the period of study was 49. There were 11 maternal mortalities during the same period. Total number of deliveries were 10566. MMR calculated was 103/100000 live birth. Maternal near miss rate calculated 461/100000 live birth.
Maternal near miss mortality was analyzed under following headings
1. Demographic profile of patient with maternal near miss
2. Referral status of patient with maternal near miss
3. Obstetric characteristic of patient with near miss
4. Neonatal outcome

Table 1: Demographic profile of patient with maternal near miss

Age (yr)	Number of Near miss 2019-2020	Percentage	Annual stat 2019-2020	Percentage
>18	2	4.1	23	0.22
18-24	20	40.8	4376	42.39
25-29	14	28.6	3590	34.78
30-34	9	18.4	1702	16.49
35-40	4	8.2	632	6.13
Residence	Number of Near miss 2019-2020		Percentage	
urban	20		40.8	
rural	29		59.2	
Income (in rupees)				
<500	28		57.1	
500-1600	3		36.7	
>1600	18		6.1	
Education				
0-5	1		2.0	
5-10	6		12.2	
11th to Degree	34		69.4	
Degree and above	8		16.3	

While analysing the demographic profile, it is seen that majority of near miss cases belongs to 18-24 age category (40.8%) and was comparable to the age pattern of women delivering in our institution. 42.39% of deliveries in our institution during the same time period was in the age group 18-24 yr. In the study group 30-34 age category constituted 18.4%where as in general

category the corresponding percentage was 16.49% which was also comparable. Similarly in the study group 35-40 was 8.2% whereas in general category it was 5.73%.Majority of near miss cases were from rural areas (59.2%) while the rest of them were ie 40.8% from the urban areas.57.1% of them belongs to low socioeconomic group. This was based on the income they state in the hospital and was collected from the case sheet.Only 2% had education of below 5th standard, while 69.4% had school level education and 16.3% had college level education. This may be due to high literacy rate of the state.

Table 2: Referral status of patient with maternal near miss

Booking status if near miss cases		
Booked in SATH	15	30.6
Booked outside	28	57.1
Unbooked	6	12.2
Annual booking status		
Booked in SATH	7500	72.65
Booked outside	2807	27.18
Unbooked	17	0.165
Place of referral		
Community health center	1	2.0
Medical college hospital	4	8.1
Private hospitals	10	20.4
Direct admissions	15	30.61
First referral unit	19	38.8
Timing of reference		
Timely	29	82.9
Late	6	17.1

This table shows the booking status of the near miss cases.as we can see 30.6% were booked at SATH and 57.1% were booked outside. 2 of the unbooked cases were below 14 weeks of gestation. Of 49,69.39% were referred cases.

The table illustrate the referral pattern of near miss cases. References are mainly from FRU 38.8% followed by private hospitals 20.4%. Referrals from medical college include patients from other departments (with high-risk medical conditions eg SLE, cardiac disease or renal disease) as well as from other medical colleges.

Of the 49 cases 35 cases were referred and of that 82.9 percent was timely references. High risk cases like placenta accrete spectrum were identified earlier using ultra sound and were referred at or before 32 weeks.in 82.9% of cases the sequela was anticipated and referred timely.in all these 82.9% vitals were stable at the time.

Table 3: Obstetric characteristic of patient with near miss

Parity	Frequency	Percentage
Nullipara	12	24.5
Primipara	24	49
Para 2	12	24.5
Para 3 and above	1	2
Status of patients		
Antepartum	27	59.18
Intrapartum	4	26.53
Postpartum	16	14.28
Mode of delivery in near miss cases	**Frequency**	**Percentage**
Spontaneous expulsion	1	2.2
Vaginal delivery	8	17.77
Caesarean section	36	80
Annual statistics		
Vaginal deliveries	6056	58.66
Caesarean section	4267	41.33

This table reflects the parity demographics of study population. 49% of the near miss are primiparas. Nulliparas and para 2 constitute 24.5% each.

There was 1 case of ectopic rupture and 1 case of post abortal bleeding among the 49 near miss cases. Rest of the 45 patients were grouped as antepartum intrapartum and postpartum. Of the 49 cases 3 were early antenatal who does not need early termination 1 was MTP. Remaining 45 cases were analysed.

80% of the near miss cases has undergone caesarean section of which Caesarean hysterectomy was performed in 13 patients I e 31.1%. There were 2 patients with intrapartum rupture uterus, both were induced patients. Compared to the annual statistics caesarean rate was higher among the near miss cases. In 51.1% of cases, we did LSCS, of which in 31.1% cases underwent obstetric hysterectomy
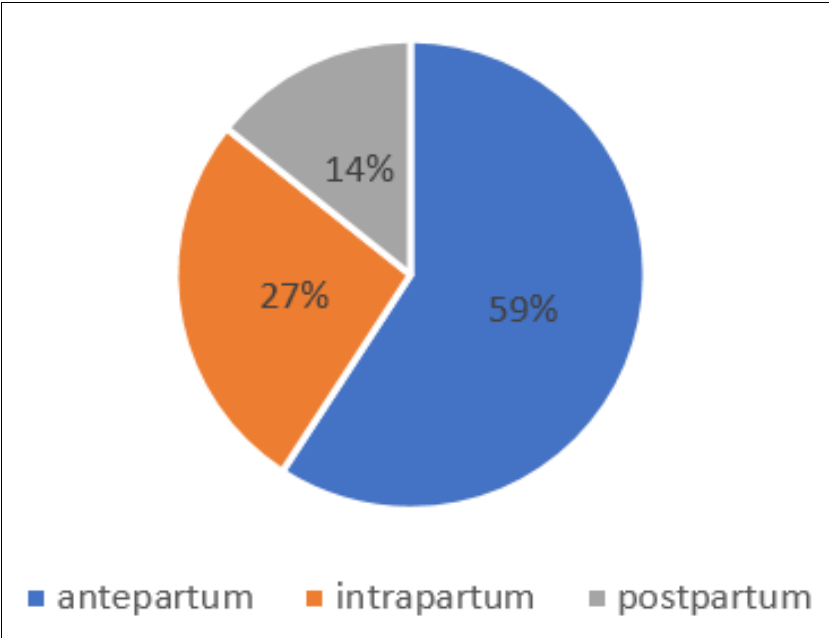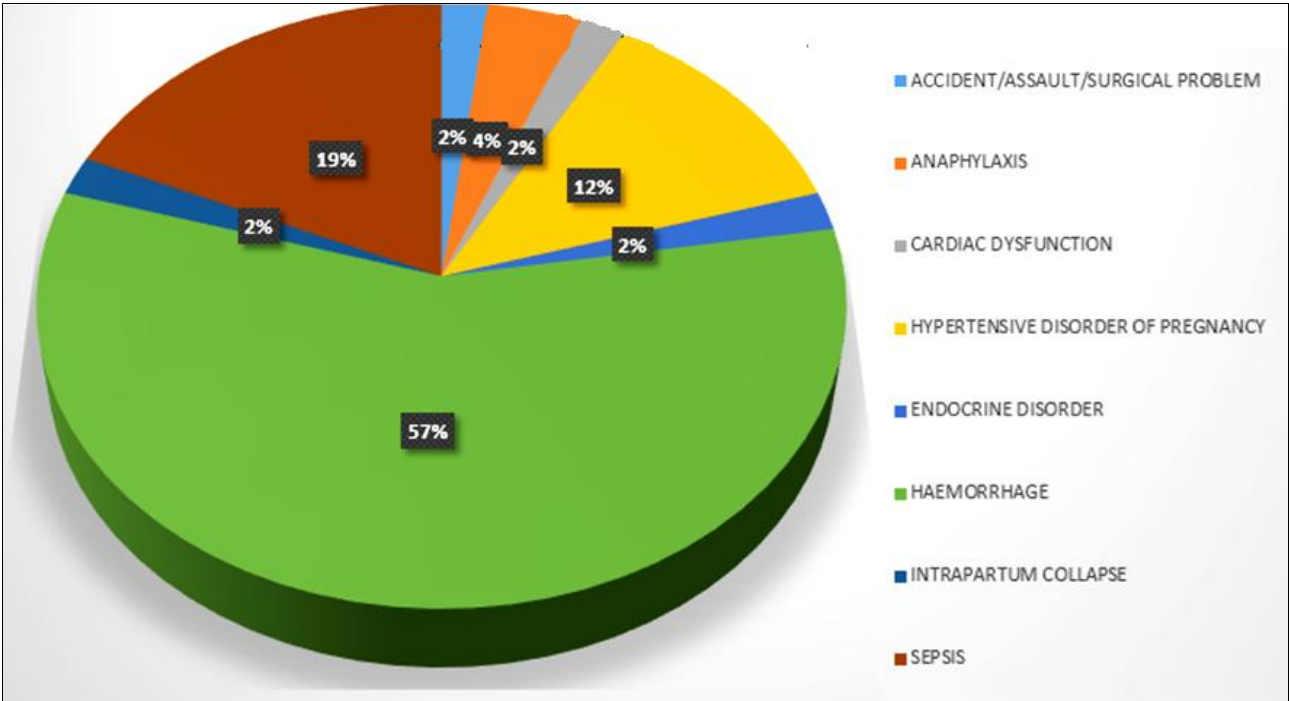
Fig 1: Timing of near miss events

On analysing this data majority of cases were Antepartum 59.18%, intrapartum 26.53

% and postpartum 14.28%. Early antenatal include post abortal complication and ectopic rupture.

From this table it is evident that the main 3 causes for near miss were haemorrhage (57.14%) sepsis (18.37%) and hypertensive disorders of pregnancy (12.24%). Of the 5 eclampsia cases 3 were referred antenatal and 2 were referred postnatal. There was 2 case of c/c ITP needing multiple blood and platelet transfusion, were treated with iv ig methyl prednisolone.

Table 4: Causes of near miss

Antepartum causes of near miss	Number	Percentage
Placenta accreta spectrum	9	33.33
Hypertensive disorder of pregnancy	6	22.22
sepsis	5	18.51
Cardiac dysfunction	1	3.70
Surgical cause	1	3.70
Severe thrombocytopenia ITP	2	7.4
Endocrine disorder (thyrotoxicosis)	1	3.70
Placenta previa	2	7.4
Intrapartum causes of near miss		
Anaphylaxis	1	25
sepsis	1	25
Intrapartum collapse	1	25
Placenta accreta in labour	1	25
Postpartum causes of near miss		
Post-partum haemorrhage	11	68.75
Rectus sheath hematoma	1	6.25
Sepsis	3	18.75
Anaphylaxis	1	6.25

Placenta accreta spectrum disorder constitutes 33.33% of antepartum near miss. Followed by hypertensive disorders of pregnancy 22.22% and sepsis accounting for 18.51%. Intrapartum near miss were anaphylaxis sepsis intrapartum collapse and placenta accrete in labour

Table shows that 42.85% of near miss in postpartum period was due to post-partum haemorrhage, followed by sepsis 18.75%

Table 5: Causes of haemorrage

Causes of Haemorrhage	Frequency	Percentage
Adherent placenta	10	35.71
Atonic PPH	7	25
Atonic PPH & Traumatic PPH	4	14.29
ectopic rupture	1	3.57
post abortion	1	3.57
Placenta previa	2	7.14
post LSCS rectus sheath haematoma	1	3.57
severe thrombocytopenia	2	7.14
Causes of obstetric hysterectomy		
Adherent placenta	9	69.23%
Atonic PPH	3	23.07%
Uterine rupture	1	7.6%

The causes for haemorrhage in this study were antepartum haemorrhage, post-partum haemorrhage, ectopic rupture and post abortal bleeding. It is interesting to note that adherent placenta was the major cause of haemorrhage (34.5%) and obstetric hysterectomy, followed by atonic and traumatic PPH (39.29%). In 13 cases obstetric hysterectomy was performed. Of the 13 obstetric hysterectomy 69.23% was done for adherent placenta, followed by atonic PPH

Table 6: Contributing factors to near miss and sequelae

Primary obstetric factors in near miss	Frequency	Percentage
No obstetric complications	30	63.3
Multiple pregnancy	1	2.04
Previous CS	8	16.32
Previous CS, placenta acreta spectrum	10	18.36
Medical illness		
drug allergy	2	4.08%
Epilepsy	1	2.04%
Hypertension	6	12.24%
hypothyroid	9	18.36%
Psychiatric illness	1	2.04%
Respiratory disease	2	4.08%
Gestational diabetes mellitus	9	18.36%
ITP	2	4.08%
Anaesthetic complication	**Frequency**	**Percent**
Aspiration pneumonia	1	2
Not applicable	4	8.2
Nil complication	44	89.8

Blood transfusions		
Not Given	20	40.81
Given	29	59.18
Postpartum complication		
CCF	1	2.04
Thromboembolism	1	2.04
Renal failure	2	4.08
DIC	3	6.12

That was a case of severe preeclampsia HELLP, were we did emergency LSCS, patient had aspiration pneumonia post operatively and went into sepsis. Anaesthetic complication was seen in only 1 case. Of the 49 cases 36.73% had no post-partum complication. 6.12% went to DIC and 4.08% had renal Failure. 59.18% needed massive transfusion. Including PRC platelet concentrate and cryoprecipitate. Mean PRC used was 5 pint, platelet used was 4 packet and cryo used was 5

Table 7: Neonatal Outcome

According to Gestational age	Frequency	Percentage
Term	20	44.4
Preterm	25	55.6
Total	45	100
Status of babies at birth (live/iud)		
IUD	3	6.7
Live	42	93.3
Nicu admission		
No admission	19	45.23
Admitted	23	54.76

Of the 49 cases 4 of them were antenatal, who were either early antenatal in whom termination of pregnancy was not warranted or ectopic for which we did laparotomy. Remaining 45,25 of them (55.6%) were preterm ie gestational age less than 37 weeks and 20 (44.4%) were term babies ie more than or equal to 37 weeks. 3 of them were intrauterine death all were preterm 2 of them were below 1 kg. Most of the babies ie 54.76% has to be admitted in NICU. Most of them were admitted due to prematurity and respiratory distress.

Discussion
Present study is a descriptive study of near miss cases admitted in HDU, stage 2 labour room and MITU, SATH during the year 2019-2020.The study is designed to find out the causes of near miss and the epidemiological factors contributing to near miss. Total number of near miss cases were 49 while there were 10323 deliveries, which constitutes 0.47% of total deliveries and 11 maternal deaths in SATH during the study period.
Analysing the demographic profile, age distribution was comparable with the annual statistics, 40.8% were in 18-24-year age group in near miss group, followed by 25-29 year. Near miss among elderly patients were 8.2%. In annual statistics of SATH, 6.13% patients were elderly age. 57.1% of the near miss cases belong to low socioeconomic status and 59.2% were from rural areas. In our study 69.39% were referred and booked outside cases but were referred timely. According Kamal *et al*. majority of near miss cases were in the age group 18-24 which was comparable with our study. 80% of cases were unbooked which was comparable with our study. In another study by Dessalegn *et al*. The age group of patients were 20-34 years, and were from rural areas which concur with our study [6]. When it is said timely, the vitals were almost stable at the time of admission to tertiary centre and we have got time to plan the management.

For example, placenta accrete spectrum which was detected at around 28 weeks were referred so that we could do a Magnetic resonance imaging and arrange blood and plan early termination. In case of haemorrhage medical management with oxytocin methergin, condom tamponade is done in majority of cases before referring. Prevalence of near miss was higher in late trimester and postpartum period compared to early trimesters. In our study 40% of cases were referred from peripheral hospitals. Regarding the antenatal check-ups 82.7% had regular antenatal check-up. This represents a good trend. It reflects high literacy rate, High rates of institutional deliveries and high rate of antenatal care in Kerala. This can be mainly due to the awareness created among the people regarding the importance of having regular antenatal check-up.
Regarding the causes of near miss about 57.14% of near miss were due to haemorrhage. Next major cause was sepsis 18.37% followed by hypertensive disorders of pregnancy i.e 12.24%. In a study conducted by Kaur L *et al*. a 1 ½ year prospective study they used WHO near miss criteria for identifying near miss. The maternal near miss incidence ratio was 22.5.in there study also most common cause of near miss was haemorrhage followed by hypertension [7].
The causes for haemorrhage in our study were antepartum haemorrhage, post-partum haemorrhage, ectopic rupture, and post abortal bleeding. Most common cause of haemorrhage was post-partum haemorrhage. According to world health organization, Postpartum haemorrhage (PPH) is defined as a blood loss of 500 mL or more within 24 hours after birth and affects about 5% of women giving birth all over the world [2]. When we analysed the causes of haemorrhage, Atonic PPH was the most common cause of PPH 35.71% followed by adherent placenta. 10 cases of adherent placenta were there in the study constituting about 32.1% of cases of PPH. Atonic +traumatic constituted 10.7% cases and traumatic alone caused 7.1% of cases. The main stay of management in atonic PPH was medical management with massive blood transfusion following massive transfusion protocol. 44.82% (13 cases) of PPH warranted obstetric hysterectomy. Of the 13 obstetric hysterectomies done during this period 9 of them (61.5%) were for adherent placenta and 100% of them had history of previous caesarean. 3 obstetric hysterectomies were done for atonic PPH and 1 for uterine rupture. There were 2 cases of uterine rupture both were induced patients. One of them underwent obstetric hysterectomy where as other underwent rent repair. According to "why mother die," Kerala 2010-2020 maternal fetal medicine committee KFOG, 65.7% of maternal near miss in Kerala are due to haemorrhage. Placenta accrete contribute to maximum number of haemorrhagic causes and this often leads to hysterectomy. This underlines the need to reduce primary caesarean section rate. Raising number of placenta previa accrete cases are more thought provoking. Placenta previa accrete cases are bound to increase because of the increasing number of caesarean deliveries. Even though mortality is low due to various techniques like aorta clamp, uterine artery embolization, blood transfusion facilities, morbidity raises concern. From the annual

statistics total caesarean section done in the year 2019-2020 was 41.33% which is nearly half of the total deliveries. The indication of caesarean section needs to be audited and unnecessary caesarean should be avoided. Other causes of haemorrhage are ectopic rupture for which emergency laparotomy and right total salpingectomy was done with massive blood transfusion. Pre transfusion haemoglobin was 5.1g/dl. It was seen that sepsis coexist with haemorrhage in case of PPH. But the factor that led to near miss was haemorrhage. Hence included under haemorrhage criteria. 3 of the patients went into disseminated intra vascular coagulation as a sequela to haemorrhage and 2 of them developed renal failure due acute blood loss and hypotension. According to a study conducted by Kamal *et al*. most common cause of near miss was haemorrhage 42.5%, followed by hypertensive disorder of pregnancy. In contrast to our study most of the cases of PPH were due to rupture uterus followed by placenta accrete spectrum [8]. Next major cause was sepsis which was comparable with ours. Sepsis constituted the next largest cause of maternal near miss. Out of 9 cases of sepsis 17.24% was antepartum 28.57% was postpartum and 7.6% was intrapartum sepsis. All patients responded to high grade antibiotics like piperacillin tazobactam vancomycin or meropenem. There was one case of aspiration pneumonia in which emergency LSCS was done for severe pre-eclampsia HELLP. There was a case of measles pneumonitis in which patient went into sepsis and severe thrombocytopenia and respiratory dysfunction. She was kept in non-invasive ventilation. Another case of disseminated tuberculosis in sepsis and respiratory dysfunction was also noted in which patient improved on starting anti tubercular treatment. Of the 9 cases of sepsis, 4 needed ventilatory support and 9 needed higher antibiotics like meropenem. In 2 patients tigecycline was also given. In the audit conducted by KFOG "WHY MOTHER DIE" sepsis was the second major contributor [9], which was comparable to our study. A multidisciplinary approach including the infection disease department, anaesthesia team and obstetric care was given to the patients. Early detection of sepsis and appropriate antibiotics are very important in reducing the morbidity. Here comes the importance of hospital antibiograms. Rational use of antibiotics (keeping in mind the antibiotic resistance which is really a topic of concern) should be practiced. It is worth to mention the importance of seeking help from infectious disease department and microbiology department.

Hypertensive disorders of pregnancy which was the second most common cause of near miss 1 decade back, occupies the third position. But still eclampsia develops in a significant number of patients. of the 6 patients 5 were eclampsia and 1 was severe preeclampsia with impending signs, HELLP who needed cardiorespiratory support post LSCS. According to "WHY MOTHER DIE" audit report conducted in Kerala hypertensive conditions were comparatively less among the near miss cases. Its comparable with this study. In a previous study conducted at SATH "determinants of maternal near miss in a tertiary care centre, suhurban *et al* during the year 2017 which was a case control study pre-eclampsia contributed the main role followed by haemorrhage and eclampsia which was in contrast to our study in which haemorrhage is the major cause [10]. It has reduced substantially now due to the timely use of antihypertensives and MgSO4. Early detection of chances of pre-eclampsia using uterine artery doppler pulsatile index in 11-13-week scan and 18-20-week scans, prophylaxis using aspirin in high risk also plays a very important role in preventing pre-eclampsia. The awareness about hypertensive disorders in

pregnancy and warning signs should be made among pregnant women. Attaining ideal body mass index before pregnancy should be emphasised in prenatal counselling, as obesity is one of the major risk factors for gestational hypertension gestational diabetes mellitus etc. Also, other medical diseases like SLE should be treated before becoming pregnant. Study by Das *et al* reported massive blood transfusion in 38% cases, magnesium sulphate therapy in 18% cases, ICU admission in 2.8% cases, higher antibiotic uses in 10% cases, peripartum hysterectomy in 5.21% and dialysis in 1% cases. In a study conducted by Namrata ray *et al* Hypertension and Haemorrhage are the leading causes of near-miss events [11].

During antenatal period, preeclampsia was the major determinant in our study placenta accrete constituted the major portion. Haemorrhage was the major determinant in intra op /intra natal cases which contrasted with our study in which intrapartum collapse, sepsis, anaphylaxis, and haemorrhage shared 25% each. Post-partum haemorrhage eclampsia preeclampsia were the major determinants in post-partum /post op cases. All this shows the changing trend of near miss and emphasize on regular surveillance on this topic.

Other interesting causes of near miss are infections and incidental causes like surgical causes and anaphylaxis. there was a case of measles pneumonitis and disseminated Tuberculosis. Surgical cause of near miss we encountered was a case of ileocecal intussusception presented with feature of acute abdomen, for which intestinal resection was done with the help of surgical team. There was a case of anaphylaxis to injection cefotaxime. These cases are of rare occurrences and less anticipated. Hence presence of mind and team work is always a must to obstetrician. There was a case of thyrotoxicosis who presented with tachycardia and altered consciousness. She had irregular antenatal check-up and and poor socioeconomic status due to which hyperthyroidism was not detected earlier landed up in thyrotoxicosis. She required ICU admission cardiorespiratory support and mechanical ventilation. She was started on propylthiouracil. Number of ectopic cases were less may be due to the availability imaging technique like transvaginal and trans abdominal ultrasound scans.

About the primary obstetric factors haemorrhage hypertension and maternal medical illness were the 3 main initiating obstetric events of near miss.it was noticed that the rate of LSCS was higher among near miss cases this may cause increase in morbidity. It was seen that early involvement of multidisciplinary team at the tertiary care centre had a huge impact on patient outcome. Mean hospital stay for near miss patient was calculated as 11 days where as ICU stay was 5days.Coming to the baby details, Of the 49 cases 4 of them were antenatal, who were either early antenatal in whom termination of pregnancy was not warranted or ectopic for which laparotomy was done. Remaining 45,25 of them (55.6%) were preterm and 20 (44.4%) were term. Most of the babies needed NICU admissions due to prematurity and respiratory distress. This study reveals a lot of avoidable factors in spite of having a great achievement in the health care sector in the state. We still have problems related to patients, administrative problems and problem related to care. Pregnant women who suffer complication need to asses to essential obstetric care which is effective in treating the complication of pregnancy which cannot be predicted or prevented. This does not mean building large infrastructure or buying costly equipment. These facilities may exist, but may have gone without repair may be drugs are not available or physician may lack appropriate training. So, what is needed is modest input, improved management, and supervision.

Avoidable problems that were identified as contributing factors to near miss mortality while doing the near miss audit

Major problems identified were lack of money, ignorance or family reluctant to seek medical support. Ignorance means patient and her family is unaware of the importance of regular antenatal check-ups. This cause late identification of the problems and appropriate medical interventions. Most of the patients live in rural areas with low income. The lack of autonomy in decision making and mobility may also be a reason why women could not adhere to the regular ante natal check-up. The distance to available health facilities and efficiency of transportation and cost of healthcare and transportation may also hinder the patient from seeking health care. Health education programme, community level ante natal care rendered by Asha workers and JPHN are remarkable in reducing the distance between the patient and the healthcare facilities.

Life saving measures to tackle obstetric emergencies like availability of blood and blood products, oxytocin for managing PPH, MGSO4 for preventing eclampsia, round the clock anaesthesia team and obstetrician should be made available in the peripheral hospitals at least at the first referral units. Emergency obstetric care is not available at most of the primary care centres and the mother in most situation will reach the skilled care when she is already past the point at which intervention can be successful.

Problem related to care include lack of problem identification improper management plan and missing information. The main aim of antenatal care is to identify problems early and screen high risk pregnancy so the earlier referral is possible. In short, decreasing maternal morbidity depends of an efficient referral system. The doctors and staff at primary health care centre should be given adequate training in identification of problems early and should be instructed to refer the patient to higher centre as soon as the problem is identified.

It is very evident that strengthening the secondary level institutions with adequate staff medicine and infrastructure can prevent patients from reaching critical stages. Early detection of high-risk factors anticipation of complications appropriate management plans and early referrals can lead to better outcome. Good communication between the periphery and referral hospital and transportation facility is also very important for a better outcome.

Conclusion

This retrospective descriptive study highlights maternal near miss as a significant indicator of severe maternal morbidity and a sensitive marker of the quality of obstetric care in a tertiary referral centre. Haemorrhage was identified as the predominant cause of maternal near miss, accounting for more than half of the cases, with atonic postpartum haemorrhage being the most frequent underlying etiology. The substantial contribution of adherent placenta to haemorrhagic near miss cases and the high rate of obstetric hysterectomy reflect the increasing burden of abnormal placentation and the complexity of managing severe obstetric haemorrhage in contemporary obstetric practice.

Sepsis emerged as the second most common cause of maternal near miss, underscoring the continued importance of infection prevention, early diagnosis, and aggressive management of obstetric infections. Hypertensive disorders of pregnancy constituted another major contributor, reaffirming their persistent role in severe maternal morbidity despite advances in antenatal surveillance and treatment protocols.

The findings of this study emphasize that timely recognition of complications, early referral, availability of blood and blood products, skilled multidisciplinary care, and prompt surgical intervention are critical in preventing progression from severe morbidity to maternal mortality. Regular audits of maternal near miss cases can provide valuable insights into gaps in care and help in strengthening health systems. Focused strategies aimed at prevention and optimal management of obstetric haemorrhage, sepsis, and hypertensive disorders are essential to reduce maternal near miss events and improve overall maternal outcomes.

Recommendation

There is a changing trend in the causes of maternal near miss; therefore, continuous surveillance is essential. Peripheral hospitals should be equipped with adequate manpower and resources. Skilled training should be provided to the obstetric team for the management of postpartum haemorrhage, hypertensive disorders, sepsis, and thromboembolism. Antenatal classes to educate women regarding pregnancy and childbirth, recognition of warning signs, and the need for regular antenatal check-ups should be conducted in all peripheral hospitals. Adequate laboratory facilities and blood bank services should be made available in maternity hospitals. Proper antibiotic usage, early detection of sepsis, and regular monitoring by the hospital infection control committee are necessary. In certain geographical areas, availability of blood and blood products remains a challenge; hence, blood storage units should be established. Early referral with a proper referral form and an accompanying doctor in a well-equipped ambulance is required when critical conditions occur at peripheral centres. A dedicated obstetric emergency team comprising an obstetrician, anaesthetist, and intensivist should be established in all tertiary care centres. Preeclampsia screening using uterine artery pulsatility index and PAPP-A should be offered to all antenatal women. Prenatal counselling emphasizing maintenance of an optimal body mass index and control of pre-existing medical disorders should be offered to all women.

Author's Contribution

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of data, drafting and critical revision of the manuscript, and approved the final version.

Conflict of Interest

The authors declare no conflict of interest.

References

1. United Nations Children's Fund (UNICEF). Maternal mortality rates and statistics. UNICEF Data. https://data.unicef.org/topic/maternal-health/maternal-mortality/. Accessed December 29, 2021.
2. Government of Odisha, National Rural Health Mission. Maternal near miss operational guidelines. Available from: http://www.nrhmorissa.gov.in/writereaddata/Upload/Documents/Maternal_Near_Miss_Operational_Guidelines.pdf. Accessed December 15, 2021.
3. Maternity Worldwide. Millennium Development Goal 5 -

results.https://www.maternityworldwide.org/the-issues/achieving-mdg-5-the-facts/. Accessed December 16, 2021.

4. Umadevi S, Ayesha S, Radha S, Nair ATS, Sulochana KD. Burden and causes of maternal mortality and near-miss in a tertiary care centre of Kerala, India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2017;6(3):807-813.

5. National Perinatal Epidemiology Unit, University of Oxford. MBRRACE-UK: Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK. Available from: https://www.npeu.ox.ac.uk/mbrrace-uk. Accessed February 7, 2022.

6. Dessalegn FN, Astawesegn FH, Hankalo NC. Factors associated with maternal near miss among women admitted in West Arsi Zone public hospitals, Ethiopia: unmatched case-control study. Journal of Pregnancy. 2020;2020:6029160.

7. Kaur L, Mohi MK, Kaur B, Singh B. A study of maternal near miss cases in tertiary health centre in North India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2018;7(8):3239-3243.

8. Kamal S, Roy P, Singh S, Minz J. A study of maternal near miss cases at tertiary medical college of Jharkhand, India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2017;6(6):2375-2380.

9. Paily V, Ambujam K, Rajasekharan Nair V, Thomas B. Confidential review of maternal deaths in Kerala: a country case study. BJOG: An International Journal of Obstetrics and Gynaecology. 2014;121(Suppl 4):61-66.

10. Determinants of near miss mortality in a tertiary care centre. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. https://www.ijrcog.org/index.php/ijrcog/article/view/1687/1447. Accessed November 16, 2023.

11. Ray N, Patil SK, Kshirsagar NS, *et al*. Maternal near miss in a tertiary care hospital: a cross sectional study. Journal of Evolution of Medical and Dental Sciences. 2016;5(51):3252-3254.