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REVIEW OF BLOOD CROSS-MATCH ORDERING AND TRANSFUSION PRACTICES FOR ELECTIVE HYSTERECTOMIES AT SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE: FIRST STEP TOWARDS A MAXIMUM SURGICAL BLOOD ORDERING SCHEDULE

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ABSTRACT

BACKGROUND: Requesting blood before surgery is a common practice. Studies show that majority of blood requested by surgeons are not utilized and this over ordering practices of blood will create a burden on the transfusion service. It diverts blood from the pool and makes it unavailable for other needy patients.

OBJECTIVE: The objective of this study is to assess the blood requesting and utilization patterns in relation to elective hysterectomies preformed at Saint Paul's Hospital Millennium Medical College (SPHMMC) in Addis Ababa.

METHODOLOGY: A hospital based retrospective study was conducted at SPHMMC from February to March 2014. All elective hysterectomies performed in the time period of September 2011 to August 2013 were included for the study and the associated blood cross-match ordering and transfusion practice was audited.

RESULT: A total of 532 units of blood were cross-matched for the 265 patients who underwent hysterectomies. But, of those only 74 (13.9%) units of blood were transfused to 39 (14.7%) patients. The findings of this study has also shown that for vaginal hysterectomy there is no need to prepare blood while for abdominal hysterectomy, abdominal hysterectomy with salpingo-oophorectomy and de-bulking surgery for ovarian tumour preparing only a unit of blood is enough.

CONCLUSION: The results of the study showed that for most of the elective hysterectomies performed at SPHMMC, the level of blood utilization was minimal and there is significant over ordering of blood and associated wastage of resources. The process whereby fixed units of blood are requested for every patient irrespective of the diagnosis and type of surgical procedure should be revised.

KEY WORDS: Surgery, elective hysterectomy, blood transfusion and transfusion indices

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INTRODUCTION

Preoperative blood ordering is usually based on subjective anticipation of blood loss instead of evidence based estimates of average requirement in a particular procedure. Studies have depicted that there are gross over ordering practices of blood to be transfused comparing with the actual or anticipated needs [1-3]. Many units of blood routinely ordered by surgeons are not utilized, but are held as reserve and become unavailable for other needy patients.

This results in inventory problems for blood banks, loss of shelf life and wastage of blood. It also causes unnecessary wastages of laboratory reagents and other pertinent resources like human and time. Moreover, such practices have greater implications in resource-constrained settings of the poor countries like Ethiopia.

Elective hysterectomy is one of the surgical procedures in which significant intra-operative blood loss is anticipated and cross-matched blood is ordered pre -operatively. The accompanying blood loss and need for blood products depends on different factors which includes the route of surgery and indication for the hysterectomy. At Saint Paul's hospital in Addis Ababa at least two units of blood are cross-matched routinely for all elective hysterectomies. Such injudicious preoperative over ordering of blood can burden the physical and human resources of the health care facility and also increase the cost of medical care [4, 5].

A Maximum Surgical Blood Order Schedule (MSBOS) is a system which provides evidence based guidelines for frequently performed elective surgical procedures by recommending the maximum number of units of blood to be cross-matched preoperatively. A MSBOS reduces the preoperative cross matching of blood in surgical cases in which there is less likelihood of blood transfusion [6].

There are various transfusion indices which include Cross-match to Transfusion Ratio (C/T ratio), Transfusion

Probability (%T), Transfusion Index (TI) and Maximal Surgical Blood Order Schedule (MSBOS) for assessing the appropriateness of blood ordered to an anticipated surgical procedure to be performed. The following formulas illustrate how to calculate the different indices of blood ordering practices in case of various surgical procedures as required. C/T ratio =No. of Units Cross-Matched/ No. of Units Transfused The use of C/T ratio was first suggested by Boral Henry in 1975. Ideally, this ratio should be1.0 but a ratio of 2.5 and below was suggested to be indicative of efficient blood usage [6]. %T=No. of Patients Transfused X 100/ Number of Patients Cross-Matched. The use of %T was suggested by Mead *et al* in 1980 and a value of 30% and above has been suggested as appropriate [3].TI= No. of Units Transfused/ Number of Patients Cross-Matched

TI signifies the appropriateness of numbers of units cross matched. A value of 0.5 or more is indicative of efficient blood usage [6].

Maximal Surgical Blood Order Schedule (MSBOS) =1.5 x TI

MSBOS estimates the amount of blood that will be needed for the individual procedures [6].

Implementation of maximal surgical blood order

schedule has almost universally resulted in substantial reduction of direct and indirect costs. It was also proven to be an effective tool for quality assurance by reducing the stress on the blood transfusion services, more efficient use of blood stocks and reduction in the wastage due to outdating [7].

Thus, this retrospective study on units of blood required and transfused for elective hysterectomies was conducted to find out the current transfusion practices as a first step towards developing a MSBOS for Saint Paul's Hospital in Addis Ababa and other health facilities in the country as required.

METHODS AND MATERIALS

This is a hospital based retrospective study conducted at SPHMMC in Addis Ababa, the capital City of Ethiopia. Saint Paul Hospital is a tertiary level referral and teaching hospital which provides health services to more than 200,000 people annually who are referred from all corners of the country.

The operation theatre registration book was used to identify all the elective hysterectomies done in previous two years, i.e., between September 2011 and August 2013. The medical records of all patients were retrieved and relevant information was extracted from operation and aesthesia

notes, patient history and progress notes using a structured questionnaire. Those patients whose medical records were not available were excluded.

Data was analysed using a Statistical Package for Social Sciences version 20.0. The C/T ratio, Transfusion Index (Ti), Transfusion probability (%T) and Maximum Surgical Blood Order Schedule (MSBOS) of elective hysterectomies done for various diagnoses and modalities of hysterectomy were determined.

Ethical clearance was obtained from the institutional review board of SPHMMC prior to the actual data collection. No identifiers were used for any collected data and the questionnaires used for collecting data were kept in a safe and secured conditions during both the study and data entry period. Finally they were discarded in a safe place after successfully completing the data entry process.

RESULTS

During the study period a total of 1,023 gynaecologic surgeries were done of which 312 (30.5%) were elective hysterectomies. Forty seven medical records (15.1%) were missed and the study was conducted on a total of 265 patients, making the retrieval rate 84.9%.

From the 265 patients 126 (47.5%) were from Addis Ababa city administration, 89 (33.6%) from Oromia Region, 32 (12.1%) from SNNPR and the rest (6.8%) were from other regions of the country.

The mean age of the patients included in the study was 46 with a SD of 11 years and ranged between 20 and 85 years.

The most common indication for hysterectomy was uterovaginal prolapse which accounted for more than half (54.7%) followed by symptomatic myoma (17.0%) and ovarian tumour (15.1%). The other identified indications for hysterectomy are shown in table 1. The most commonly performed operative procedures was vaginal hysterectomy as shown in table 2. The average pre-op haematocrit was 39 % with a SD of 6% (Table 3). The lowest mean haematocrit (30%) was found in those with a diagnosis of gesta-

tional trophoblastic disease. The average duration of surgery was 87minutes with a SD of 32 minutes.

The average intraoperative blood loss was 338 ml with a SD of 204 ml. The mean blood loss ranges from 50 ml for elective hysterectomies done for UVP to 1000 ml for ovarian tumours. The average duration of hospital stay was 12 days ranging from 6 to 57 days. The majority of patients stayed in the hospital for less than 10 days. Almost all patients, i.e., 264 (99.6 %) were discharged with good outcomes but one patient (0.4%) died. During the study period, a total of 532 units of blood were requested and cross-matched for elective hysterectomies. Of those, a total of 74 units transfused to 39 patients and that makes the utilization rate of prepared blood only 13.9%.

Among those twelve (16.21%) were transfused preoperatively, 41 (55.40%) intra operative and 21 (28.39%) were transfused in the post-operative period.

Among the 12 units of blood which were transfused preoperatively for 6 patients, one unit was transfused for a woman who had vaginal hysterectomy; four units for two cases who had abdominal hysterectomy; one unit for a patient for whom debulking surgery was done for ovarian tumour and the rest six units for two patients who had abdominal hysterectomy and bilateral salpigo-oophorectomy.

Of the 41 units of blood transfused in the intra operatively, 24 units were transfused to 14 patients who were diagnosed as cases of myoma; 13 units of blood to 6 patients admitted with a diagnosis of ovarian tumour and the rest 4 units were to patients admitted with other diagnoses including GTD. The operative procedures done to the patients who had intraoperative transfusions were abdominal hysterectomy for 11 patients; de-bulking surgery for 6 patients with ovarian tumour and abdominal hysterectomy with salpingo-oophorectomy for 5 patients.

The remaining 21 units of blood (28.37%) were transfused during the post-operative period to a total of 11 patients**.** These patients had a diagnoses of GTD (36.37%), myoma (18.18%), ovarian tumour (18.18%), myoma with ovarian pathology (18.18) and UVP (9.09%).

The transfusion indices were calculated separately for the different indications and modalities of hysterectomies as shown in tables 4 and 5. The maximum C/T ratio of 96.66 was found for cases of uterovaginal prolapse and the minimum for GTD which was 1.57. Conversely the maximum %T of 63.63% was found for GTD and the minimum of 1.37% was found for uterovaginal prolapse (Table 4).

With regard to the operative procedure the maximum C/T ratio of 96 was found for vaginal hysterectomy and the minimum was for abdominal hysterectomy which was 2.5. The %T was least for vaginal hysterectomy (1.4%) indicating that less than two percent of blood is being utilized (Table5).

DISCUSSION

The study objectively evaluated the blood ordering and transfusion practice related to elective hysterectomies. It has revealed a significant over ordering of blood for elective hysterectomies with only 13.9 % of the cross-matched blood being actually trans-

fused which is significantly below the recommended 30%. However, the finding of this study is comparable with the findings of other similar studies conducted in other countries. For instance, a prospective observational study done in Bir Hospital in Nepal showed that the blood requisitions were made to 79 patients who had undergone surgery in the general surgical department. Among 198 units of blood that were made available for these patients, only 27 (13.6%) units of blood were transfused to 18 (22.8%) patients [9].

It is recommended that hospitals keep their C/T ratio below 2.5 and TI above 0.5 for efficient utilization of blood and blood products (6).The overall C/T in this study was found to be 7.18 and the TI was 0.28. The findings of both indices have shown that there is significantly high over ordering of blood for transfusion in surgical settings. The C/T ratios of our findings are also much higher than the findings from the study conducted at the Main University Hospital in Egypt which showed the overall C/T ratio of 3.9 and TI was much lower than the 0.69 of the Main University hospital study [10].

When disaggregated by the types of indications for surgery, all the three indices showed that there was significant blood utilization for the elective hysterectomies performed for cases of GTD, myoma and associated ovarian masses. On the contrary, only 1.34% blood cross-matched for uterovaginal prolapse was utilized indicating the unnecessary wastage of resources and laboratory personnel's time in cross-matching the 98% of units of blood which were not used. Similarly, when the blood utilization is assessed by the routes of surgery, only 1.4% of cross-matched blood was utilized for vaginal hysterectomies.

The Maximum Surgical Blood Order Schedule (MSBOS) is a table of elective surgical procedures which lists the number of units of blood routinely cross-matched for each procedure pre-operatively. The schedule is based on a retrospective analysis of actual blood usage associated with the individual surgical procedure. It aims to correlate as closely as possible the amount of blood cross-matched to the amount of blood transfused [8].

Applying MSBOS to our study has showed that, for vaginal hysterectomy, there is no need to prepare blood while for abdominal hysterectomy, abdominal hysterectomy with salpingo-oophorectomy and de-bulking surgery for ovarian tumour only 1 unit of blood is enough. When the indication for hysterectomy is considered, 2 units of blood should be prepared for cases of GTD and myoma with associated ovarian pathologies, for other cases of myoma and ovarian tumours, one unit of blood would suffice. Only blood grouping and typing should be done for cases of uterovaginal prolapse. The MSBOS guideline prepared by University of Chicago Medical Centre has relatively comparable recommendation. According to this guideline, for vaginal hysterectomy the blood type and screen or nothing (at surgeon's discretion) is recommended. But 2 units of blood should be prepared for ovarian cancer de-bulking and radical hysterectomy and in cases of abdominal hysterectomy for benign condition blood type and screen is recommended [11, 12].

The slight differences between the findings of this study and that of recommended in the guide line might be due to the fact in this study there were only 3 patients for whom radical hysterectomy was included that making generalization difficult.

CONCLUSION

As demonstrated in this study, there was significant over ordering of blood and wastage of resources associated with elective hysterectomies. The practices of requesting the fixed units of blood for each patient irrespective of the diagnosis and the procedure should be revised. In addition, the physicians should be clear with the number of units of blood they are supposed to request for each surgery. A system in which only the blood group should be determined prior to surgery should be instituted for surgeries anticipated to have insignificant blood loss. Finally, the MSBOS should be also determined for all the other surgical cases to be performed in the hospital setting and similar others.

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Table 1- Indications for elective hysterectomies done at SPHMMC between September 2011 and August 2013, Addis Ababa, Ethiopia

	Number of pa-	Percent
Uterovaginal prolapse	145	54.7%
Symptomatic myoma	45	17.0%
Malignant ovarian tumour	40	15.1%
Gestational trophoblastic disease	11	4.2%
Other ovarian masses	7	2.6%
Others	17	6.4%
Total	265	100%

Table 2: Operative procedures of elective hysterectomies done at SPHMMC between September 2011 and August 2013, Addis Ababa, Ethiopia

Operative procedure	No. of patients	Percent (%)
Vaginal hysterectomy	144	54.3
Abdominal hysterectomy	43	16.3
Abdominal hysterectomy with Salpingo-oophorectomy	35	13.2
De-bulking surgery for ovarian tumour	40	15.1
Radical hysterectomy	3	1.1
Total	265	100

Table 3. Characteristics of patients who have undergone elective hysterectomy at SPHMMC between September 2011 and August 2013 by admission diagnosis, Addis Ababa, Ethiopia

Admission diagnosis	Mean age (years) ± SD	Mean pre-op Hct (%) SD±	Mean duration of surgery (minutes) ± SD	Mean intra op blood loss (ml) ± SD	Mean post op Hct (%) ±SD	Mean duration of hospital stay(days) ± SD
Uterovaginal prolapse	49±12	41±4	78±23	267±169	36±5	11±5
Symptomatic myoma	40±6	38±7	96±42	384±180	34±5	15±8
Ovarian tumour	44±10	38±6	106±34	473±265	34±6	16±10
GTD	38±6	30±10	73±17	375±177	30±5	13±4
Myoma +Ovarian pathology	42±9	34±15	110±47	350±71	33±12	14±5
Other ovarian mass	45±5	39±2	95±27	250±132	39±2	13±3
Cervical ca	48±15	42±4	120±44	400	41±10	10±1
Other	47±5	41±3	113±39		34±4	17±1
Total	46±11	39±6	87±32	338±204	35±5	13±7

Table 4: Transfusion indices by operative procedure and indication for elective hysterectomies done at SPHMMC between September 2011 and August 2013, Addis Ababa, Ethiopia

		C/T	%T	TI	MSBOS
Operative procedure	Vaginal hysterectomy	96	1.4%	0.02	0.03
	Abdominal hysterectomy	2.5	41.2%	0.8	1.2
	De-bulking surgery for ovarian tumour	5.1	20.0%	0.4	0.6
	Abdominal hysterectomy with salpingoopherectomy	3.5	28.6%	0.6	0.9
Intra op diagnosis	Myoma	3.21	35.55%	0.62	0.93
	Ovarian Tumour	4.55	22.5%	0.45	0.67
	GTD	1.57	63.63%	1.27	1.90
	Myoma+Ovarian pathology	2.00	44.44%	1.0	1.5
	Uterovaginal prolapse	96.66	1.37%	0.02	0.03
	Total	7.18	14.7%	0.28	0.42

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RISK FACTORS FOR MATERNAL MORTALITY AMONG ECLAMPTICS IN HAWASSA UNIVERSITY REFERRAL HOSPITAL, 2016

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ABSTRACT

INTRODUCTION: Globally eclampsia is an important cause of morbidity and mortality during pregnancy, child birth and puerperium. Early intervention and provision of critical care for those at risk of significant morbidity and mortality is important.

OBJECTIVE: To identify important risk factors for maternal mortality among eclamptic women managed in Hawassa University Referral Hospital.

METHODOLOGY: A five years retrospective case - control analysis of risk factors for maternal mortality among eclamptic women was done. Cases were those mothers who died and the controls were those who survived. Data was collected from patient charts and variables were assessed among cases and controls to identify risk factors for mortality. Odds ratio with 95% confidence interval and P- values were computed.

RESULTS: The majority of eclamptics were below 26 years of age, 95 (65 %); primigravida, 76 (52 %) and from out of Hawassa, 95 (65 %). Five or more convulsions before admission (OR = 3.90, 95%CI, 1.64 – 9.37), creatinine level above 0.9 mg/dl (0R = 7.73, 95%CI, 2.84 – 21.63) and platelet count less than 100,000/mm^3 (OR = 11.20, 95%CI, 3.70 – 36.32) were significantly associated with the risk of mortality at admission. The case fatality rate of eclampsia was 24% and the most important causes of deaths were respiratory failure and acute renal failure.

CONCLUSION: Closer follow up should be considered for those eclamptics with 5 or more convulsions before admission; and elevated creatinine level and thrombocytopenia at admission. The quality of care provided in the intensive care unit should be improved.

KEY WORDS: Eclampsia, Risk factors for maternal mortality at admission

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INTRODUCTION

Eclampsia is a multi-systemic disease with significant maternal complications and is one of the most important causes of maternal mortality in the world.

The incidence of eclampsia is cited to be in the order of 2–8 cases per 10,000 deliveries in developed countries and up to 16–69 cases per 10,000 in developing countries [1, 2]. Several recent studies from Canada and Ireland have demonstrated a decline in eclampsia incidence over time. Liu et al found a decline from 12.4 per 10,000 to 5.9 from 2003 through 2009 in Canada, while O'Connor et al found a decline from 5.4 per 10,000 to 3.5 over a span of 30 years in Ireland [1, 3]. Incidence surveys have been undertaken in England and Wales since 1922: these show a continuous decline in both incidence and deaths from the condition [4]. However epidemiological studies conducted during the last decade showed no decline in the incidence of eclampsia in developing countries. A study done by Wagnew M et al in governmental hospitals in Addis Ababa showed a 154% rise in its incidence in the last five years [5]. Eclampsia currently is also the leading cause of maternal death in our country unlike the previous decades when the proportion of deaths from eclampsia has been rising but from abortion and other causes has been declining [6].

Eclampsia is associated with significant maternal morbidities like pulmonary oedema, aspiration pneumonia, acute renal failure, disseminated intravascular coagulation, intracranial bleeding and abruption placenta [7]. Of eclamptic cases, 2–20% are complicated by perinatal loss, while 1–20% are complicated by maternal fatality, with the highest rates of morbidity and mortality in developing countries [8].

The management of eclampsia includes controlling the blood pressure and the convulsion; and supportive care which includes the management of complications.

The objective of this study is to identify important independent risk factors for mortality among eclamptic mothers admitted and managed in Hawassa University Referral Hospital (HURH). The hospital is the only referral hospital in the Southern Ethiopia providing a comprehensive obstetrics and intensive care services.

METHODS

In this retrospective case - control study, patients diagnosed as eclampsia between September 2008 and August 2013 in the Department of Gynecology and Obstetrics of HURH were included: cases were those who died and the controls were those who survived. Patients' information was obtained from hospital records. The exclusion criteria were pregnant patients with hematologic or other diseases with increased hepatic enzyme levels and convulsions due to other causes like epilepsy, severe malaria and meningitis.

Eclampsia is defined as the occurrence of seizures in a woman with preeclampsia that cannot be attributed to other causes.

Gestational weeks of the patients were determined according to the last date of menstruation and/or ultra-sonographic measurements. Vital signs of all patients were monitored, and magnesium therapy was initiated. Loading dose of magnesium (4 g) was

administered in 20 minutes followed by 10gm intramuscular stat, and maintenance dose 5gm intramuscular was given every 4 hours till 24 hours after delivery. Diazepam instead of magnesium sulphate was administered if the urine output was not adequate. At the time of admission, variables such as blood pressure, whole blood counts, SGOT, SGPT, and serum creatinine were evaluated. Termination of the pregnancy was done for all eclamptic women after stabilization. Vaginal delivery was preferred; however, in the presence of unfavorable cervix, fetal distress, mal-presentation and in patients with previous caesarian delivery abdominal delivery was made. The association between maternal age, address, ANC booking, gestational age, parity, onset of convulsions, number of convulsions before admission, convulsion to delivery interval, systolic and diastolic blood pressure, platelet count, levels of SGOT, SGPT and creatinine levels were evaluated for use as risk factors of the maternal mortality.

Means and standard deviations (SD) were calculated for continuous variables. The Chi-square test and the Student's t test were used to evaluate differences between the categorical and continuous variables. Logarithmic transformation (log10) was performed to correct the variance of SGPT, and SGOT, as the range of those distributions was very large. The logistic regression analysis was used to find the independent risk factors at the time of admission for mortality among eclamptic patients and to calculate the odds ratios.

Two-sided *p* values were considered statistically significant at $p < 0.05$. Statistical analyses were carried out using the statistical package SPSS 16 and EPi Info version 6.

RESULTS

From September 1, 2008 to August 31, 2013, a total of 174 mothers with a diagnosis of eclampsia were admitted to the labor and maternity ward of HURH. One hundred and sixty three (93.6%) charts of eclamptic mothers were retrieved and 146 (89.5%) charts were reviewed. Of the remaining 28 charts, ten lost, thirteen incomplete and five excluded by exclusion criteria which were two epilepsy cases, two severe malaria, and 1 meningitis cases that was transferred to medical side.

Among patients who were admitted to the hospital with a diagnosis of eclampsia, ninety four (64.4%) patients developed one or more maternal complications and there were 35 maternal deaths, making the case fatality rate of eclampsia to be 24%.

Mean age of the mothers was 24.71 ± 4.57 years. Majority of the patients were in the age group of 21-25 years; 55 (37.7 % and came out of Hawassa, 95 (65 %). Primigravidas constituted the highest number of eclamptics; 76 (52 %). Majority of eclamptic mothers had at least one ANC follow up (84.2 %). Regarding the gestational week the highest proportion of eclamptics presented at or above 37 weeks of pregnancy (42.5 %) and only 7.3 % of them were below 28 weeks (Table 1).

Majority of patients 95(65 %) had their convulsion before the onset of labor while 41(28 %) were intrapartum and the remaining 10(7 %) occurred postpartum. One hundred twenty three (84.2%) patients had reported symptom before convulsion; headache

110 (75.3%), blurred vision 89(61%) and epigastric pain 40(27.4%) while the rest 23(15.8%) had no any premonitory symptoms. The majority of eclamptics had less than 5 convulsions before admission (61 %); however, more cases (62 %) than the controls (31 %) had more than 5 convulsions before being admitted to the hospital which was found to be statistically significant risk factor for mortality among eclamptics in this study with OR = 3.90, 95%CI, 1.64 – 9.37 (Table 2 and 3). For the majority of the cases the interval between the first convulsion to delivery was 12 hours or more (77 %) but it was only in 37 % of the controls. This finding was also found to be statistically significant, OR = 5.60, 95%CI, 2.17 – 14.89 (Table 2 and 3).

The mean maximum admission systolic blood pressures were 163.53 ± 30.74 mm hg and 163.60 ± 18.53 mm hg for the cases and the controls, respectively. The mean maximum admission diastolic blood pressures were 109.41 ± 16.87 mm hg and 109.37 ± 13.02 mm hg for the cases and the controls, respectively. There was no statistical significant difference between the cases and the controls regarding the mean maximum admission systolic and diastolic blood pressures.

The mean admission logSGOT and logSGPT were 1.9 ± 0.5 and 1.9 ± 0.4 for the cases; and 1.8 ± 0.3 and 1.7 ± 0.3 for the controls, respectively. There was a statistically significant association between these transaminases and mortality among eclamptics in this study (Table 3).

About 80 % of the cases had platelet count less than 100,000/mm^3 at the time of admission compared to only 32 % of the controls as seen on Table 2. This finding showed a statistically significant difference between the cases and the controls (OR = 11.20, 95%CI, 3.70 – 36.32). Regarding the serum creatinine level at admission, the majority of the controls (60 %) had a normal value (≤0.9 mg/dl); but a significant proportion of the cases (68.6 %) had a serum creatinine value above 0.9 mg/dl. This finding was also significantly associated with the risk of dying from eclampsia, OR = 7.73, 95%CI, 2.84 – 21.63 (Table 2 and 3).

The most important complications were respiratory complications and oliguria. Respiratory complications included aspiration pneumonia, pulmonary edema and hospital acquired pneumonia. About 34% and 17% of the total eclamptics developed pulmonary complications and oliguria after admission to the hospital. There were a statistically significant associations between theses complications and the risk of mortality, OR = 5.02, 95%CI, 2.08 – 12.23 and OR = 13.63, 95%CI, 4.67 – 41.09 respectively (Table 3).

On multivariate analysis of risk factors for mortality at admission to the hospital namely the logSGOT, logSGPT, number of convulsions before admission, platelet count and serum creatinine level, it was found out that 5 or more convulsions before admission (OR = 5.68, 95%CI, 1.81 – 17.84), platelet count less than 100,000/mm^3 (OR = 8.75, 95%CI, 2.76 – 27.78) and serum creatinine level above 0.9 mg/dl (OR = 9.33, 95%CI, 2.85 – 30.48) were independent risk factors for mortality among eclamptics in this study.

DISCUSSIONS

The case fatality rate of eclampsia in this study (24%) was found to be higher than other similar studies done in similar facilities, 5% in Tanzania and 8% in Nigeria [9,10]. Although the case of fatality rate is a result of different factors including delay in detection of disease early at the preeclamptic stage, it mainly reflects the sub optimal quality of care given by the hospital regardless of the hospital being the only one in the area where more critical patients are referred.

Different similar studies demonstrate that age greater than or equal to 30 years, low socioeconomic status black race, multiparity, having no ANC, gestational age remote from term and the presence of lateralizing signs to be independent risk factors for mortality in pregnancy complicated with eclampsia [11,12]. These risk factors are related with the severity of the diseases or the availability of services especially critical care service or otherwise due to the awareness or the health seeking nature of the community.

Other studies revealed that SGPT, SGOT, serum LDH level, serum bilirubin level, HCT and thrombocytopenia and the presence of post partum hemorrhage as independent risk factors for mortality in eclamptic women [13, 14]. Increased systolic and diastolic blood pressures are also associated with the risk of mortality [15, 16]. These risk factors reflect the involvement of multiple systems and the presence of complications or the failure to detect and manage them might be the strong risk factors behind. It may also reflect the contribution of HELLP syndrome for mortality in eclamptics. Systolic hypertension of eclampsia is an etiologic factor for increased risk of maternal mortality. Evaluation of previous literature findings has revealed that intracerebral bleeding due to hypertension was also linked with increased mortality [17]. Cerebrovascular events in eclampsia appear to constitute a continuum characterized by an initial, reversible phase of vasogenic edema and seizures caused by hypertension, along with endothelial dysfunction [18]. Still, hypertension associated with HELLP syndrome also disrupts blood-brain barrier secondary to endothelial dysfunction [16].

These findings are not similar with the findings of this study where serum creatinine level, thrombocytopenia and increase numbers of convulsions are the most important independent risk factors. These differences might be due to the differences in the sample size and study facilities as well as the differences in the study populations.

However, the finding of this study is similar with other studies where the increased numbers of convulsions before admission to the hospital was found to be an independent risk factor for mortality in pregnancies complicated with eclampsia [19]. Increased number of convulsions before admission in eclamptic women may explain the presence of profound brain edema or intracerebral bleeding due to the diseases advancement and severe hypertension or failure of early initiation of care.

The most important complications in this study were respiratory complications 50 (34%), oliguria 26 (18%) and abruption placentae 17(12%), while the most important causes of mortality were respiratory failure 12 (35%), acute renal failure 9 (26%) and

multiple organ failure 7 (20%) which are directly or indirectly related with the most important independent risk factors of mortality in the eclamptic women in this study, namely the increased number of convulsions before admission and increasing level of serum creatinine. It may be important to improve the quality of care delivered to eclamptic women with respiratory failure as well as to monitor the serum creatinine level of eclamptic women and to consider a dialysis service in the hospital

in order to decrease mortality in eclamptic women in the hospital. Regarding the management of eclamptics in the intensive care unit there were lots of deficits observed. To mention few points only 5 eclamptics out of 12 mortalities with respiratory failure were intubated, the rest were getting oxygen with face mask and nasal catheter. Only 2 cases of acute renal failure out of 9 were referred for dialysis to Saint Paul's hospital. This is mainly due to the absence of anesthesiologists in the hospital.

A well noted fact in the analysis of these cases was the absence of adequate and appropriate investigations. The association of deranged liver enzyme levels and thrombocytopenia with mortality of eclamptic women on the bivariate analysis might tell the contribution of HELLP syndrome if serum LDH, HCT and peripheral morphology were included in the evaluation of these patients as some literatures found out that HELLP syndrome is concomitantly found in 5 – 6 out of 10 deaths associated with eclampsia (20, 21).

CONCLUSION AND RECOMMENDATIONS

Increased level of serum creatinine, thrombocytopenia and number of convulsions before admission are important independent risk factors for mortality in eclamptics in the hospital. It is important to have a closer follow up for eclamptics with these risk factors in the hospital. Having a dialysis service and anesthesiologists in the hospital should be considered a priority to improve the quality care.

Table 1 – Demographic and obstetric variables of eclamptics admitted to HURH, Hawassa, Ethiopia, 2008 – 2013.

Variables		Cases		Controls		Total	
		Number	Percent	Number	Percent	Number	Percent
Age in years	≤ 20	8	23%	32	29%	40	27.4%
	21 – 25	17	49%	38	34%	55	37.7%
	26 – 30	6	17%	31	28%	37	25.3%
	>30	4	11%	10	9%	14	9.6%
	Total	35	100%	111	100%	146	100%
Address	Hawassa	17	48.6%	34	31%	51	35%
	Out of Hawassa	18	51.4%	77	69%	95	65%
	Total	35	100%	111	100%	146	100%
Marital status	Married	25	71.4%	64	57.7%	89	61%
	Single	10	28.6%	42	42.3%	57	39%
	Total	35	100%	111	100%	146	100%
ANC booking	Yes	30	85.7%	93	83.8%	123	84.2%
	No	5	14.4%	18	16.2%	23	15.8%
	Total	35	100%	111	100%	146	100%
Parity	Primigravida	16	45.7%	60	54%	76	52%
	1 – 5	15	42.8%	48	43%	63	43.2%
	≥6	4	11.4%	3	2.7%	7	4.8%
	Total	35	100%	111	100%	146	100%
Gestational age	<28 weeks	2	5.7%	8	7.3%	10	6.8%
	28-33 weeks	15	42.8%	35	31.5%	50	34.2%
	34-36 weeks	4	11.5%	20	18%	24	16.5%
	≥37 weeks	14	40%	48	43.2%	62	42.5%
	Total	35	100%	111	100%	146	100%
Pregnancy	Singleton	33	94%	103	93%	135	93.2%
	Twin	2	6%	8	7%	10	6.8%
	Total	35	100%	111	100%	146	100%

Table2. Clinical and Laboratory Variables of Eclamptics Admitted to HURH, Hawassa, Ethiopia, 2008 –

Variables		Cases		Controls		Total	
		Number	Percent	Number	Percent	Number	Percent
Time of onset	Antepartum	21	60%	74	66.7%	95	65%
of convulsion	Intrapartum	12	34.3%	29	26.1%	41	28%
	Postpartum	2	5.7%	8	7.2%	10	7%
	Total	35	100%	111	100%	146	100%
Number of convulsions	1- 4	13	37.2%	76	68.4%	89	61%
before admission	5-10	11	31.4%	29	26%	40	27.4%
	>10	11	31.4%	6	5.4%	17	11.6%
	Total	35	100%	111	100%	146	100%
First convulsion to	<12	8	22.8%	68	61.3%	76	52%
delivery interval in hours	12-24	20	57.2%	33	29.7%	53	36.3%
	>24	7	20%	8	7.2%	15	10.3%
	Unknown			2	1.8%	2	1.4%
	Total	35	100%	111	100%	146	100%
Platelet count	<100,000/mm^3	28	80%	36	32.4%	64	43.8%
at admission	≥100,000/mm^3	5	14.3%	72	64.9%	77	52.8%
	Unknown	2	5.7%	3	2.7%	5	3.4%
	Total	35	100%	111	100%	146	100%
Creatinine level	≤0.9 mg/dl	8	22.9%	67	60.4%	75	51.4%
at admission	>0.9 mg/dl	24	68.6%	26	23.4%	50	34.2%
	unknown	3	8.5%	18	16.2%	21	14.4%
	Total	35	100%	111	100%	146	100%
Anticonvulsant	Magnesium sulpphate	10	28.6%	40	36%	50	34.2%
	Diazepam	25	71.4%	71	64%	96	65.8%
	Total	35	100%	111	100%	146	100%
Pulmonary complication	Yes	22	63%	28	25.2%	50	34.2%
	No	13	37%	83	74.8%	96	65.8%
	Total	35	100%	111	100%	146	100%
Oliguria	Yes	18	51.4%	8	7.2%	26	17.8%
	No	17	48.6%	103	92.8%	120	82.2%
	Total	35	100%	111	100%	146	100%
Focal neurological	Yes	4	11.4%	3	2.7%	7	4.8%
Complication	No	31	88.6%	108	97.3%	139	95.2%
	Total	35	100%	111	100%	146	100%
Abruption placentae	Yes	6	17%	11	10%	17	11.6%
	No	29	83%	100	90%	129	88.4%
	Total	35	100%	111	100%	146	100%

Table 3 – Possible Risk Factors for Mortality among Eclamptics Admitted to HURH, Hawassa, Ethiopia, 2008 – 2013

Variables	Cases		Controls		Test value	OR (95 % CI)	P - Value
	Number	Percent	Number	Percent			
>5 convulsions before admission	22/35	63 %	33/109	30.3%	χ^2= 11.91	3.90 (1.64-9.37)	0.000
≥12 hours between first convulsion & delivery	27/35	77 %	41/109	37.6 %	χ^2=16.61	5.60 (2.17-14.89)	0.000
Pulmonary complications	22/35	63 %	28/111	25 %	χ^2=16.73	5.02 (2.08-12.23)	0.000
Oliguria	18/35	51.4 %	8/111	7.2 %	χ^2=35.55	13.63 (4.67-41.09)	0.000
Platelate count below 100,000/mm^3	28/33	84.8 %	36/108	33.3%	χ^2=27.06	11.20 (3.70-36.32)	0.000
Serum creatinine above 0.9 mg/dl	24/32	75 %	26/93	28 %	χ^2=21.95	7.73 (2.84-21.63)	0.000
Mean logSGOT[a]	29/35	82.8 %	73/111	65.8%	t=2.039	_____	0.042
Mean logSGPT[b]	30/35	85.7%	81/111	73%	t=2.057	_____	0.044

a= mean admission logSGOT ± standard deviation for the cases was 1.8 ± 0.3 and for the controls was 1.9 ± 0.5. b= mean admission logSGPT ± standard deviation for the cases was 1.7 ± 0.3 and for the controls was 1.9 ± 0.4.

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CASE CONTROL STUDY ON DETERMINANTS OF PERINATAL DEATH IN GHANDI MEMORIAL HOSPITAL, ADDIS ABABA, ETHIOPIA

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ABSTRACT

INTRODUCTION: Perinatal Mortality is a sensitive indicator of the quality of service provided to pregnant women and their newborns. Although data is lacking from community studies, hospital log books can help to get useful information. Some of the risk factors for PNM are avoidable if they are known with carefully controlled studies.

OBJECTIVE: To assess determinants of perinatal mortality Gandhi Memorial Hospital and determine the probable causes of death.

METHODS: This study was done in 2011. The study design was unmatched case control study to compare the multiple risk factors between perinatal deaths and their sampled live birth controls in Gandhi Memorial Hospital. The sample size for cases was 220 while for controls 440.

RESULT: In this study PNM was found to be 50.8/1000 live births. Preterm delivery was 35%, LBW was 45% and Malpresentation 24.6% among cases and these were significantly higher than the controls. Maternal booking status, malpresentation, vaginal route delivery, prematurity and LBW were important determinants of PNM. Most of the deaths didn't have explainable cause of death. Of the known causes congenital malformation and mechanical cause are the most common. Parity and multiple gestations were not found to be predictors of perinatal deaths.

CONCLUSION& RECOMMENDATIONS: LBW and preterm deliveries were important determinants of PNM. Thus the delivery unit in the hospital should make improvements in the neonatal care services. Improved documentation of obstetric information is important to reduce the number of unexplained causes of death. Improved ANC and intrapartum care can play important role to reduce PNM in Gandhi memorial hospital (GMH.)

KEY WORDS: Perinatal mortality, Gandhi memorial Hospital, Ethiopia, Determinants

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INTRODUCTION

Over 9 million children in the world die very early during the perinatal and neonatal periods. Nearly all (98%) of these deaths occur in the developing world. Trends in mortality show that perinatal and neonatal mortality are declining less rapidly compared to infant and under-five Mortality [1].

Although being newborn is not a disease, large numbers of children die soon after birth: many of them in the first four weeks of life **(neonatal deaths)**, and most of those during the first week **(early neonatal deaths)**. For every baby who dies in the first week after birth, another is born dead **(fetal deaths or stillbirths)**. Causes and determinants of neonatal deaths and stillbirths differ from those causing and contributing to post neonatal and child deaths. [1]

WHO has estimated that the number of perinatal deaths world wide to be greater than 7.8 million of which more than 98 percent happening in developing countries. In Africa a perinatal mortality as high as 75 deaths per 1000 live births is reported. In Asia it is in the range of 36 to 74 per 1000 live births. Since 1990's there was a decline in the perinatal death in many parts of the world. But the decline is variable by region. Sub-Saharan Africa displayed slower progress in reducing neonatal mortality. [2]

Underreporting remains a problem, especially with regard to early deaths and stillbirths in particular. Data on stillbirths are less frequently available than data on deaths after birth, and are most prone to underreporting. Stillbirth data are available for fewer countries and are less consistent than early neonatal and neonatal mortality data. [1]

Misclassification of live births and deaths can also occur; there may be misunderstanding of the definition of live birth and fetal death, or misunderstanding of the purpose of reporting. Live births are more likely to be reported than fetal or early neonatal deaths, and nonviable births may systematically be reported as stillbirths. A review of studies on underreporting indicates that, while both live births and neonatal deaths may be underreported, fetal deaths are much more likely to go unreported. Moreover, the earlier the gestational age and the lower the birth weight, the less likely it is that birth and death will be reported. [2]

A number of studies in developed countries show that incomplete reporting of vital events varied between 10% and 30 %. Since the mid 20th century, there has been a tremendous decrease in the rate of stillbirth due to improved prevention and treatment of conditions such as diabetes, hypertension, and red cell alloimmunization. However, stillbirth rates have reached a plateau or have only modestly declined over the past several decades. [2].

The still birth rate in Africa is largely unknown because of few studies. A hospital based study done in Kenya reported a still birth rate of 30.5/1000 live births. In that study the number one cause of death was intrapartum asphyxia accounting for 45.8% of all deaths. [3] Studies have shown that good number of still births could be prevented by identification of pregnancy at risk and fetal surveillance.

The PNM in Ethiopia remains high with a national rate of 37/ 1000 live births. Two reports from large hospitals have shown mortality above 100/1000 live

births. Most of the studies in Africa and Ethiopia are simple audit reports which fail to show the important determinants for perinatal mortality. In addition little is known about the effect of other maternal demographic and obstetric factors on perinatal mortality. The aim of this study was to assess the determinants of perinatal mortality and at Gandhi memorial Hospital (GMH), the biggest maternity hospital in Ethiopia.

METHODS

STUDY AREA

The study was conducted at Gandhi Memorial Hospital which is the biggest public maternity hospital in Addis Ababa, Ethiopia. It had an estimated annual delivery rate of nearly 5000 to 7000. The hospital is also a teaching hospital for gynecology and Obstetrics residency program of Addis Ababa University (AAU) .It has a well-developed perinatal registry system. The study was conducted in 2011 and deliveries happened one year prior to the study were included for the study.

STUDY DESIGN

The study design was unmatched case control study .The cases were perinatal deaths and the controls were sampled live births in the specified time period. Lethal congenital malformations were excluded from the study.

SAMPLE SIZE AND SAMPLING TECHNIQUE

A two proportion sampling technique was used using EPI6 stat-calc software. The assumptions considered in calculating the sample size were a risk difference of 10% between cases and controls with regard to exposure for severe form of preeclampsia. In addition, a 95% confidence interval, 80% power, minimum OR of 2 and 2 to 1 ratio. The sample sizes for cases were 223 and for controls 446 .Finally 220 cases and 440 controls were taken for analysis. Controls were selected by taking two near by live births on the registry above and below deaths.

Data on maternal demographic variables, obstetric factors birth outcomes was retrieved from the appropriate register books in the labour ward. Additional variables which are not found from the log book were retrieved from patient charts after identifying patient card number and mother's name. Information retrieved was filled in the structured questioner. Variables like Maternal age, Booking status, Parity, Birth weight, sex, Gestational age, Fetal Presentation, Mode of delivery were used for analysis.

ANALYSIS

After cleaning and completing data was entered into computer SPSS software version 15.0 with proper coding. Associations with different variables were described using OR and their 95% CI. To control the effect of confounders a multivariate analysis was done by using forward conditional logistic regression model , taking variable entry criteria as p-v <0.05 and variables with substantial importance with evidences from other studies. Findings are reported with adjusted OR, and their 95 % confidence intervals.

ETHICAL CLEARANCE

Institutional board review (IRB) clearance was obtained from University of Gondar ethical committee and an official letter was submitted to hospital medical director of Gandhi Memorial Hospital.

RESULT

Table 1

There were a total of a total of 5580 deliveries in one year period prior to the study. The numbers of perinatal deaths in were 290 with the perinatal mortality 51.9/1000 live births. There were 35 missed cards making the chart retrieval rate to be 88 %. There were also 35 lethal congenital malformations excluded from the study 220 perinatal deaths were included in the study with 440 controls. 176 (80%) were IUFDs, 22(10%) were intrapartum deaths, and 22 (10%) were early neonatal deaths (ENNDS).

Table 2

This table shows the differences between the mean values maternal age, parity, birth weight and gestational age. There was significant difference between the cases and controls on birth weight and gestational age. The mean Birth weight of cases and controls was 2485.45 $\pm$ 800.5 grams and 2946.47 $\pm$ 539.17 grams respectively. The differences in the mean was significant statistically at (PV <0.001). The mean G.A of the cases & controls was 37.69 $\pm$ 4.19 weeks and 39.22 $\pm$ 3.16 weeks respectively and the difference was significant at (PV <0.05). The difference in the mean maternal age and parity were not statistically significant.

Table 3

This table shows the causes of perinatal deaths by high risk obstetric conditions. Majority of the deaths were unexplained 128 (50.2%) followed by mechanical cause 18.1%.

Table 4

Shows the bivariate and multivariate analyses of determinants using forward conditional logistic regression. On the bivariate analysis age less than 20, lack of ANC follow up, preterm delivery, low birth weight, mal-presentation and vaginal route delivery were associated with perinatal mortality. The associations of sex of the newborn, parity of the mother and twin pregnancy, timing of cesarean section with perinatal mortality were not statistically significant.

The multivariate analysis found the following factors to be independent determinants of perinatal mortality in Gandhi Memorial Hospital.

Babies born from mothers with no booking had a higher probability of death compared to booked ones (AOR=2.03). LBW (AOR = 4.02) and preterm delivery (AOR = 3.43.) were independent determinants for PNM.

Malpresentations particularly breech presentations were independent determinant of perinatal mortality with an AOR of 3.91. Vaginal route delivery was also found to be a determining factor with increased perinatal mortality. The difference was statistically significant at AOR =2.89.

DISCUSSION

Important independent predictors of PNM found in this study were no ANC follow up, low birth weight, prematurity, unassisted vaginal delivery and, malpresentations. Maternal age less than 20 was found to be a protective factor for perinatal mortality. Prim gravidity and twin delivery were not found to be independent predictors. But when gestational age was excluded from the analysis equation both factors become significant determinants.

The strength of this study is the inclusion of all the still births and ENNDs registered in the labor ward log book were during the study period. Strict inclusion and excusion criteria were used. To increase precision 1:2 ratio between cases and controls was taken.. Case ascertainment was done in such a way that after taking the mothers name and card number tracing was done to find the charts. Analysis was done for only variables with less missing value.

The limitations of this study are, ENNDs who died after discharge or referral to NICU were not included for lack of means of tracing. Poor documentation and lack of information on important variables like HIV, duration of labor, presence of meconium and other confounding variables on patient charts had created difficulty in making comparisons.

The PNM was higher than the national average which is 37/1000 live births [6]. It is also higher than reports from Zimbabwe (34.5/1000) and Nigeria (30.4/1000) [9, 10]. But much lower than reports from teaching hospitals in Tanzania and India, 124 and 142.5/1000 live births respectively [13,14]. The difference from the national average is obviously due the fact that the hospital is a referral center where every complicated case from periphery are coming and are expected to have a higher PNM than the population based national estimate.

Lack of Antenatal follow up was found to be an important determinant of perinatal mortality in this study. This is consistent with several other studies which have showed that more perinatal deaths happen in the not booked ones [15].

Age less than 20 years was found to be a protective factor for PNM in this study which is not consistent to other studies. This could be the problem of age ascertainment as more mothers do not know know their exact ages.

Low birth weight and prematurity were found important factors associated with PNM. This finding has been reported by several reports. [7-14] This is due to the well known fact that these factors are related with poor maternal medical and obstetric consequences. But most importantly lack of proper and immediate neonatal care could be the unforeseen reasons [15].

Malpresentations especially breech presentation was found to be proportionally important factor causing mortality .This is consistent with similar findings in other studies and is due to its associated obstetric complications like prematurity, cord accidents and congenital malformations. Breech vaginal delivery is the protocol in the hospital and it might have contributed for increased deaths as well. This necessitates for the importance of training of skills of vaginal breech delivery for the midwives and physicians [5].

Even though, this study found that vaginal route delivery to be associated with increased PNM than abdominal route, it should be carefully interpreted that vaginal delivery is less safe. The majority of the perinatal deaths have associated mechanical labor problems and antepartum hemorrhage; these comorbidities are commonly contraindications for vaginal deliveries.

Generally, this study has identified determining factors for determinants of PNM in Gandhi memorial hospital (GMH.)

CONCLUSION AND RECOMMENDATION

Perinatal mortality was found to be an important problem in Gandhi Memorial hospital. Low birth weight and prematurity are important causes of perinatal mortality. Other determining factors for perinatal mortality are lack of ANC follow up, vaginal breech delivery. The majority of perinatal deaths have unexplained cause of death .Birth asphyxia and pre-term deliveries were the leading causes of neonatal deaths. So prevention and treatment of premature babies should improve. Prevention strategies for low birth weight should strengthen. Breech delivery protocols needs reinvestigated. In this study most of the causes of deaths were unexplainable which entails a proper documentation of the obstetric scenario at the time of delivery. On the other hand mechanical causes of death were found to be the leading cause of death which reminds the importance of an improved intrapartum care.

CONFLICT OF INTEREST

We declare that there is no conflict of interest in this study.

Table-1 Summary of Delivery Outcome in the Study Gandhi Memorial Hospital (GMH)

Delivery outcome	Number
Total Birth	5580
Total perinatal deaths	290
Cases Included in the Study	220
Controls	440
Still births	198
Early neonatal deaths (ENND)	22

Table- 2 Mean Values of Maternal and Fetal Demographic and Obstetric Factors

Factors	mean for cases	mean for controls	p-value (0.05)
Maternal age	26.14+ 1.38	25.77 +5.13	0.4
Parity	2.02±1.38	2.047±1.37	0.56
Birth weight in grams	2485.45 + 800.5	2946.47 + 539.17	0.001
Gestational age	37.69 + 4.19 weeks	39.22 + 3.16 weeks	0.02

Table-3 Distribution Cases by Probable Cause of Death, GMH

Cause of death	No	%
Unexplained	128	50.2
Mechanical	46	18.1
Congenital	35	13.7
PIH	24	9.4
APH	19	7.4
Maternal Disorder	3	1.2

Table-4 Bivariate and Multivariate Analysis of Maternal and Fetal factors Affecting Perinatal Death, GMH

Maternal age	cases	controls	Crude OR (95% CI)
<20yrs	28	84	0.62 (0.39,0.98)
20-35	183	338	1
>35years	9	17	0.98 (0.43,2.24)
Parity			
Primi	109	200	1.18 (0.85,1.63)
Multi	111	239	1
Booking status			
Unbooked	36	42	1.85 (1.15,2.99)
Booked	184	398	1
Number of gestations			
Multiple	13	17	1.56 (0.75,3.28)
Single	207	423	1
Gestational age			
Preterm	77	57	3.67 (2.47,5.48)
Term	125	340	1
Postterm	18	43	1.14 (0.63,2.05)
Sex of the fetus			
Male	128	246	1.1 (0.78,1.58)
Female	92	194	
Birth weight			
1000-1499	24	2	
1500-2499	75	60	
2500-3999	114	361	
>4000	7	16	
Presentation			
Non-Vertex	54	38	

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TRENDS OF LUNG FUNCTION INDICES, ARTERIAL BLOOD OXYGEN SATURATION AND PULSE RATE AMONG THE FIRST AND THIRD TRIMESTER PREGNANT WOMEN IN ADDIS ABABA, ETHIOPIA

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ABSTRACT:

OBJECTIVE: Comparative analysis of the effects of middle-level altitude pregnancy on lung function indices, blood oxygen saturation and pulse rate as a function of gestational weeks.

STUDY DESIGN: This is a Cross-sectional descriptive study conducted in Tikur Anbessa hospital, a tertiary university hospital and Lideta Health Center a public health center located in Addis Ababa, Ethiopia.

Participants: 123 pregnant women including 40 in their first and 83 in their third trimester

RESULTS: maternal height was positively correlated with FVC and FEV1 but not with PEFR ($r=0.68$; $p<0.01$). BMI and FEV1% were also positively and negatively correlated in normal and obese subjects respectively. As term approaches, there is a decreasing pattern of PEFR, IC, VT, ERV, ($p< 0.005$) and hence FRC. However, pulse rate, VE and BF had shown a rising trend. On the other hand, FEV1%, VC, and TLC didn't change significantly. Chest size had no statistically significant effect on most of the indices. Minimal coffee intake habit and having more children were shown to have desirable pregnancy outcomes.

CONCLUSIONS: Based on the present study it is concluded that at moderate altitude, as pregnancy proceeds, some lung function indices like tidal volume and breathing frequency show an increasing tendency unlike most of the static lung function parameters. We recommend that pregnant women should be guided through the predictable physiologic and emotional changes that occur during pregnancy and help them develop coping life style strategies.

KEY WORDS: Peak expiratory flow rate, lung function indices, pulse rate, SaO_2, body mass index, chest size, middle-level altitude, first and third trimester.

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INTRODUCTION

The influence of pregnancy on the respiratory tract originates from both anatomical and physiological changes. Early maternal homeostatic changes occur due to the increased metabolic demands brought by the fetus, placenta and uterus and, in part, by the increasing level of pregnancy hormones, particularly progesterone and estrogen [1, 2]. An elevated level of progesterone observed during pregnancy may have an effect on the activity of the respiratory drive [3, 4]. Later changes, starting in mid-pregnancy, are anatomical in nature and are caused by mechanical pressure from the expanding uterus [2]. Research data and clinical observations showed that the disturbances of ventilatory function of the lungs during pregnancy are often seen in overweight and obese women [5].

As evidenced from a study on Africa-American, poor African-Americans had larger $FEV_{1\%}$ and higher BMI, but lower sitting height, FEV_1 and FVC than whites [6]. This is attributed to two socioeconomic status indicators: poverty index, a measure of current family income, and education. Poverty index accounted for about 7.5% and 2.5% of racial difference in lung function in women and men, respectively, whereas the effect of education accounted for about 2% in women and 4.7% in men [7]. Thus socioeconomic status, as measured by poverty index, was a better explanatory variable for the racial difference in women [7].

Furthermore, the functional efficiency of the lung deteriorates with age, genetic factor, and altitude. For instance, FEV1 and FVC measured in the Ethiopians are found to be lower than in whites, but higher than other Africans, Chinese and Indians [8]. Compared to sea level values, highland women (Leadville - 3,658 m above sea level) have higher ventilation and haemoglobin values, and the pregnant women had a higher hypoxic ventilator response and resting ventilation (VE) than their non-pregnant counterparts [9] yielding arterial oxygen content (SaO2) as high as pregnant women at sea level. The mean SaO_2 of Aymara adult (3,900-4000 m) was 2.6% higher than Tibetan subjects living at 3,800-4,065mt. No sex differences was noted [10]. Beall (11) also found out that Ethiopian highlanders maintain venous haemoglobin concentrations and SaO2 within the ranges of sea level populations.

Thus, ventilation and haemoglobin concentration were important variables contributing to oxygen transport during pregnancy at high altitude [12]. Hypoxic responses assess the relationship between ventilatory output and arterial O_2 concentration in the presence of a stable arterial PCO_2 [13].

Because we could not find similar studies in pregnancy in any of the African countries to make a comparison, in this study, we presented an investigation of changes of maternal lung function parameters, SaO_2 and pulse rate. Common to most studies which have been done in the area is the lack of consideration of relevant confounding variables such as altitude, socioeconomic status, education, and race.

MATERIALS AND METHODS

Study area and clients:

Addis Ababa is a mid-level altitude metropolis with an altitude range of 2300 – 2800 meters above sea level which is believed to impose mild hypoxic condi-

tion to inhabitants. Pregnant women who came to Tikur Anbessa Hospital and Lideta Health Center, for ANC, within the age range of nineteen to forty five and with singleton gestation, who consented to particpate in the study, were included. Those with respiratory diseases, obstetrics complications and painted fingernail were excluded.

Eighty-four pregnant women in their third trimester were recruited and compared with forty pregnant women in their first trimester.

Study design, methods and data analysis:

This is a cross-sectional. Maternal study .body weight and height were obtained while lightly clothed. Background information was obtained by questionnaire on the initial visit. All oxymetric (Oxi-sat 510) and spirometric (Spiro pro, Jaeger) measurements were done in morning hours in sitting positions in the antenatal clinic of the Tikur Anbessa Hospital and Lideta Health Center (Addis Ababa, Ethiopia).

The index finger was used to determine the oxygen saturation and pulse rate at rest. The haemoglobin oxygen saturation (SaO_2) measurements were taken after assessing any barriers such as nail paint (nail polish), nicotine staining, or dirt. The reading that was most displayed or the average of the most displayed numbers of the three trials was considered.

Following proper explanation and demonstration of the respective procedures by the principal investigator, subjects took rest for three to five minutes. Afterwards, six spirometry trials (three to slow vital capacity and three manoeuvres to forced vital capacity parameters) were done for each subject and the best performed trial was taken, based on the recommendation given by American Thoracic Society [16]. The Spiro pro was calibrated by a syringe of known volume (1L), every time preceding the measurement. The calibrated Spiro pro was regularly checked for ambient conditions (temperature of 17-20°C and relative humidity of 65-74% and barometric pressure of 1018-1025 hpa).

The data from each respondent was entered and analysed using SPSS version 10.0 for windows and Microsoft excel statistical software packages. Double data entry technique was used to maximize quality. Frequency distributions and cross tabulations were done for the variables. Data was also evaluated using student's t test, correlation and analysis of variance (one-way ANOVA). A p-value of less than 0.05 was declared significant.

Ethical considerations:

All subjects were briefed on the objectives and procedures of the study by the principal investigator and a nurse in the clinics. Volunteered clients underwent a medical assessment and provided written informed consent to participate. Those women who need support while being investigated were treated appropriately. Privacy and confidentiality were maintained. This study was approved by the Faculty Research and Publication Committee (FRPC) of Addis Ababa University (Ethiopia).

RESULTS

Anthropometric characteristics

The distribution of study participants with age groups is presented in table 1. Mean height was 154.9± 4.8cm in women in their first trimester and 157.8± 6.0 cm for those in their third trimester. To

categorize subjects into body mass index groups, non-pregnant weight was taken retrospectively from records. The percentage increase with respect to gestational weeks was considered (Table 1) and there is a direct correlation between BMI values calculated using pregnant and non-pregnant weight. The mean BMI values were 23.7±4.7 and 22.4 ±4.6in the first and third trimester respectively.

According to the WHO criteria, adults with BMI of less than 18.5 kg/m^2 were underweight and considered to have chronic energy malnutrition and 23 women (18.7%) were found to be in this range. Normal weight–height proportions women (BMI 18.5-24.99 kg/m^2) was found in 62, overweight grade I (BMI 25.0 - 29.99 kg/m^2) in 23 women (18.7%), over weight grade II or obese (30.0 - 39.99 kg /m^2) and overweight grade III (above 40.0 kg/m^2) were in 15women (12.2%) (Figure 1).

Lung function indices

The mean values of FEV_1, FVC, $FEV_{1\%}$, peak expiratory flow rate (PEFR) and forced expiratory flow (FEF_{25}, FEF_{50}, FEF_{75}) were within the normal limits. Differences in the arithmetic mean of these parameters in the first and third trimesters of pregnancy were not statistically significant (with the exception of PEFR; Table 2).

Slow vital capacity parameters including vital capacity (VC), expiratory reserve volume (ERV), inspiratory capacity (IC), and tidal volume (VT) showed no significant difference. There was, however, a significant difference in minute ventilation (MV) and breathing frequency (BF) between the first and third trimesters (P< 0.05, Table 5).

A rise in BMI was associated with increment in $FEV_{1\%}$; however; in obese subjects in the first trimester, there was a relative fall in $FEV_{1\%}$ value (Table 4, Figure 2). Though statistically insignificant, there was an increasing trend in the value of $FEV_{1\%}$ in the third trimester (p =0.41; r= 0.135). Though marginally significant (p = 0.046), mean PEFR in the first trimester (5.11±1.85) was larger than in the third trimester (4.79±1.49, Figure 1).

In the third trimester, maximum values of PEFR (4.98 litres/sec), FVC (3.27 litres) and FEV_1 (2.67 litres) and $FEV_{1\%}$(84.4 %) were observed in the late thirties as depicted in Table 3; While in the first trimester, we found peak values of PEFR (5.65 litres/sec), FVC (3.31 litres) and $FEV_{1\%}$(85.4 %) within the age range of 18-27 years. $FEV_{1\%}$ was found to be maximum in the mid-thirties.

As compared to other variables, there is a moderate positive correlation between maternal height and FVC, both in the first and third trimester (P<0.001). The association is more pronounced when weight is also considered (BMI).

As body mass index increased, there was a general increment in the forced respiratory parameters (FVC, FEV_1, FEF_{25}, FEF_{50}, and FEF_{75}, PEFR, & $FEV_{1\%}$). Maximum values were recorded in the BMI range of 26.1 – 29 years (Table 4). A slight decrement from the overall rising trend of the parameters was also observed in obese subjects (BMI > 29), especially of forced expiratory flow indices ($FEF_{25, 50, \&75\%}$).

There was a normal distribution of mean values of FVC with respect to chest width, maximum values being observed in the mid-range (0.17 – 0.21), and

there was a corresponding decrease in FVC values as chest circumference increases further, both in the first and third trimesters.

Both chest depth and width had no statistically significant effect on changing PEFR, FEV_1, and FVC ($p>0.05$) in the third trimester. During the first trimester, there was a statistically significant difference between mean PFT values (PEFR, FEV_1, and FVC) and chest size ($p<0.001$). There was also a correlation between chest size (as approximated from chest width) and PFT values in the first trimester with FEV_1($r=0.48$), FVC($r=0.54$), and PEFR ($r=0.61$).

Minute Ventilation was significantly increased from the first to third trimester of gestation ($p=0.042$, two tailed; $r = 0.27$). These findings were related to an increase in VT/TI ($p=0.005$,). It was also observed that during pregnancy there was a statistically significant increment in breathing frequency which is the major cause for the increase in minute ventilation ($p = 0.009$).

As depicted from table 6 and figure 2, lower level of percentage saturation of arterial blood haemoglobin (SaO_2) was associated with larger BMI value. The variation was insignificant except the slight significance in the BMI range of 19.8 – 26 kg/m^2. Obesity appeared to be synergistic in the presence of hypoxemia ($r = -0.46$).

The average pulse rate in women before 12 weeks of gestation was lower (88±12.48 beats/minutes) and there was a statistically significant increment in the third trimester, 93.60±9.13 beats/minutes ($p = 0.0003$).

As pregnancy advances, there was an increasing tendency of pulse rate (as illustrated in figure 4). Maximum value of pulse rate was measured near term. The lower and upper 95% confidence intervals in the first and third trimesters were 84.7 versus 92.7 and 91.6 versus 95.6 respectively. It is also noted that, the pulse rate but SaO_2 which is correlated positively with weeks of gestation ($p = <0.001$; $r = 0.367$).

Life style, parity, socioeconomic status and education on PFT and SaO_2

There was a negative relationship between coffee drinking habit and percentage saturation of arterial blood reference values.

Slight increase in PEFR value is also observed but in other Indian studies declining trend was observed [18]. The values in our finding are lower than those observed in Indians and Europeans [18, 19]. In addition, no change in PEFR during pregnancy was observed in European study [19]. This might be attributed to circadian rhythm i.e. maximal expiratory flow is at its lowest level during the early hours of the morning (4.00-6.00 am) and it was demonstrated that the level reaches its peak in the afternoon. This effect reflects predominately on PEFR [20]. Our tests were performed during early morning; between the hours 9.00 - 11.00 a.m. and PEFR values might be affected.

Though statistically insignificant, there is a slight increase in the value of $FEV_{1\%}$ which can possibly be due to the slight decrease in partial pressure of oxygen in Addis Ababa as compared to sea level which can stimulate the breathing centre and relieve airflow limitation. The positive correlation between PEFR and FEV_1 is in agreement with other study [21] but not in conformity with another study [18].

Many studies [22, 23 and 24], utilizing within-subject comparisons of small groups of pregnant women, showed that FVC and FEV_1 remained essentially unchanged during pregnancy which is an indication that function of the larger pulmonary airways was not altered much in reference values.

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Many studies [22, 23 and 24], utilizing within-subject comparisons of small groups of pregnant women, showed that FVC and FEV_1 remained essentially unchanged during pregnancy which is an indication that function of the larger pulmonary airways was not altered much in haemoglobin. As pregnancy progressed, the effect becomes more significant ($r = -0.41$; $p = 0.005$). High PEFR value was associated with stable emotional state while low values, though statistically insignificant ($r = -0.116$ and $p = 0.202$) were correlated with aggressiveness.

We also observed that the disturbances of ventilator function of the lungs during pregnancy are often seen in women with the highest BMI than normal women (Table 4 & Figure 1) and was more pronounced in the first trimester

After controlling for age, height, weight, and smoking, parity is associated with a higher FEV_1 ($P = 0.0002$). That is, women with greater number of children experienced an increment of FEV_1 in all reproductive age groups.

DISCUSSION

FEV_1 and FVC for females are correlated positively with height. A study in Kenya that has been done on non-pregnant men and women (17) supports our finding. Orie's work also depicts the positive correlation of height with PEFR, which is not in accordance with this study. As compared to the available values used as a non-pregnant reference (8) and the result obtained in this study, the expiratory ratios ($FEV_{1\%}$) were smaller than age-matched in the study done in Kenya [17].

Measured PEFR values for all age groups are based on the currently used reference values [8]. Observed values in both trimesters and in all age groups are compared to the reference values.

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served in Indians and Europeans [18, 19]. In addition, no change in PEFR during pregnancy was observed in European study [19]. This might be attributed to circadian rhythm i.e. maximal expiratory flow is at its lowest level during the early hours of the morning (4.00-6.00 am) and it was demonstrated that the level reaches its peak in the afternoon. This effect reflects predominately on PEFR [20]. Our tests were performed during early morning; between the hours 9.00 - 11.00 a.m. and PEFR values might be affected.

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Many studies [22, 23 and 24], utilizing within-subject comparisons of small groups of pregnant women, showed that FVC and FEV_1 remained essentially unchanged during pregnancy which is an indication that function of the larger pulmonary airways was not altered much in pregnancy. In consistent with ours, studies also confirm that $FEV_{1\%}$ is unchanged during pregnancy [25 and 26]. There was, however, no statistically significant change regarding vital capacity and total lung capacity. Cugell and associates [27] demonstrated that there is no alteration in the lung volume profile until the second half of pregnancy, at which time a decrease in both ERV and RV combine to produce an 18% mean decrease in FRC. The VC was unchanged; therefore the total lung capacity (TLC) was slightly diminished at term. Still, another group of researchers claim that while tidal volume increases, there is a progressive decrease in ERV and RV throughout pregnancy. A decrease of up to 25% in FRC occurs after the fifth to sixth month of pregnancy [5 and 28].

In this study, small decline (though statistically insignificant) in inspiratory capacity (IC) and the expiratory reserve volume (ERV) is observed as a result of which RV falls, and hence leading to a consistent decline in FRC. Many studies are in consistent with ours [5 and 28] but a study by Grace and colleagues found otherwise [25].

The study by Tracada and colleagues [29] is in consistent with this finding. This condition, consequently, will result in increased low ventilation to perfusion regions in the lung. These alterations are worsened in the supine position with its concomitant increase in intra-abdominal pressure, causing the oxygen gradient ($A\text{-}aPO_2$) to increase [29]. The finding of Knuttgen and colleagues is not in line with our study [26].

We found an increment of MV by 22% in the third trimester. Weinberger [28], however, found a raise in MV before the end of the first trimester which remains constant throughout pregnancy. Rees et al. [31] proved that respiratory frequency did not change during pregnancy and yet both resting VT and MV increased. Our finding also ascribes the observed hyperventilation to a rise in the frequency of breaths. The contribution of slight increment in depth of breathing as depicted from a rise in tidal volume is statistically insignificant. This sign of chronic hyper-

ventilation is more pronounced in the third trimester. In addition to progesterone, altitude might also have a potentiating effect on hyperventilation. At the altitude of Addis Ababa, the pregnancy-associated rise in alveolar ventilation increases arterial O_2 saturation nearly to sea level values.

Socio-environmental risk factors may differ based on individuals' status. Such risk factors, for instance, may be higher exposure to airborne pollutants, poorer housing conditions, or lower consumption of fruit and vegetables [32]. In our study, PFT parameters were found to be significantly lower in the low-income group, which is approximated from educational level and income.

The finding that obesity disturbs ventilatory function is in accordance with the results obtained by another study [33]. Consequently, maternal obesity carries significant risks for the mother and fetus [34].

There is a significant association between parity and values of SaO_2, pulse rate, MV, BF, PEFR, and $FEV_{1\%}$. A study by Harik-Khan supports our findings [35].

Income is also related to SaO_2, pulse rate, PEFR, and $FEV_{1\%}$ ($P<0.001$). This is consistent with other finding which states that lower income, inferior dietary intake and patient choice of substandard prenatal care are incompatible with healthful living [36]. Prescott [37] also found that poverty appears to have a greater effect on lung function in healthy women than in healthy men. The same study showed that FEV_1 and body mass index are related to educational level in males but not in females. It is noted that during pregnancy, lung compliance is not changed but chest wall compliance is decreased [38]. Previous study [8] had found no association between free fat mass and lung function indices. Expiratory flow rate accurately and reliably in the management of pregnant women with asthma**.** As compared to emotionally stable, courageous and spiritless pregnant women, those who are unstable, aggressive and hot-tempered have low PEFR value. Therefore, having patience and creating psychologically calm state during pregnancy might improve the process of gas exchange, which is detrimental to both the mother and the growing fetus.

In conclusion, pregnancy raised maternal ventilation and arterial O_2 saturation, with the result that arterial oxygen content was similarly maintained at non-pregnant levels. BMI at the baseline seems to predict the increase in MV, SaO_2 and $FEV_{1\%}$ with correlation observed between these values. Pregnancy does not change the FEV_1, FVC, or forced expiratory flow ($FEF_{25,\ 50\ \&\ 75\%}$); therefore, obstructive patterns during pregnancy should be thought of as abnormal rather than the result of pregnancy. Both BF and MV showed a significant increase during pregnancy, which seems to be the response to the increased demands of the growing fetus.

We believe that further studies are needed for establishment of local reference norms for Pulmonary Function Tests in different regions of altitude range of Ethiopia. By extension, the relative effect of exercise during pregnancy at altitude on PFT and SaO_2 should be worked.

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Table 1: Distribution of the study population with respect to age range in each trimester. Addis Ababa .Feb. 2005.

Gestational Week		Age group			
Trimester		18-27	28-37	38-47	Total
First	1-12	16	23	1	40
Third	28-40	34	43	6	83
	Total	50	66	7	123

Table 2: Measured lung function parameters including forced expiratory flow at 75%, 50%, 25% of FVC according to the trimester of pregnancy compared.

Parameters	First Trimester		Third Trimester		
	Mean	SD	Mean	SD	P value
FVC(in litres)	3.13	0.75	3.14	0.66	0.93
FEV_1(in litres)	2.28	0.51	2.23	0.49	0.64
$FEV_{1\%}$	84.91	6.08	82.78	9.59	0.20
PEFR(in litres/sec)	5.11	1.85	4.79	1.49	0.046*
$FEF_{25\%}$(in litres/sec)	3.48	1.35	3.24	1.06	0.29
$FEF_{50\%}$(in litres/sec)	3.15	1.14	2.91	0.99	0.22
$FEF_{75\%}$(in litres/sec)	2.17	0.68	2.02	0.70	0.24

P<0.05, mean difference between the groups is statistically significant

Table 3: Mean values of some standard pulmonary function values classified in age groups across trimester

Age group		Lung function indices			
		FVC (l)	FEV1 (l)	FEV1%	PEFR (l/sec)
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
18-27	Non-pregnant	3.16 (0.42)	2.65 (0.39)	83.89 (7.76)	6.76 (0.90)
	1st trimester (n=16)	3.31 (0.49)	2.70 (0.39)	84.55 (4.64)	5.65 (1.98)
	3rd trimester (n=34)	2.94 (0.74)	2.40 (0.63)	84.05 (5.99)	4.50 (1.54)
28-37	Non-pregnant	3.04 (0.53)	2.49 (0.39)	81.76 (7.18)	6.50 (0.94)
	1st trimester (n=23)	3.00 (0.89)	2.46 (0.67)	85.40 (6.99)	4.77 (1.73)
	3rd trimester (n=43)	3.27 (0.58)	2.56 (0.51)	81.55 (11.9)	4.98 (1.46)
38-47	Non-pregnant	2.82 (0.51)	2.29 (0.42)	80.91 (5.26)	5.42 (0.81)
	1st trimester (n=4)	2.91(0)	2.24 (0)	79.21 (0)	4.28 (0)
	3rd trimester (n=6)	3.27 (0.57)	2.67 (0.32)	84.40 (6.15)	5.02 (1.24)

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38-47	Non-pregnant	2.82 (0.51)	2.29 (0.42)	80.91(5.26)	5.42 (0.81)
	1st trimester (n=4)	2.91(0)	2.24(0)	79.21(0)	4.28(0)
	3rd trimester (n=6)	3.27 (0.57)	2.67 (0.32)	84.40(6.15)	5.02(1.24)

Table 4: Trends of forced expiratory parameters (FVC, FEV1, FEF25, FEF50, and FEF75, PEFR, & FEV1%) in accordance with the body mass index.

BMI	FVC	FEV_1	$FEV_{1\%}$	$FEF_{25\%}$	$FEF_{50\%}$	$FEF_{75\%}$	PEFR
<18.5 (Group 0)	2.91(0.59)	2.34(0.53)	83.13(7.85)	2.90(1.08)	2.63(0.90)	1.87(0.75)	4.34(1.46)
18.5 – 24.9 (Group 1)	3.11(0.75)	2.47(0.61)	82.39(9.72)	3.16(1.10)	2.80(1.03)	1.91(0.66)	4.69(1.56)
25 – 29.9 (Group 2)	3.23(0.58)	2.61(0.45)	84.31(9.37)	3.60(.88)	3.23(0.89)	2.32(0.63)	5.23(1.24)
>30 (Group 3)	3.43(0.37)	2.78(0.36)	83.86(7.25)	3.55(0.99)	3.32(1.01)	2.29(0.66)	5.18(1.39)

Table 5: Respiratory pattern parameters in the group of pregnant women studied

PFT values	First Trimester	Third Trimester	p-value
Vital capacity (litres)	2.39 (0.26)	2.36 (0.47)	>0.05
Expiratory Reserve Volume(litres)	0.69 (0.16)	0.60 (0.22)	>0.05
Inspiratory Capacity (litres)	1.79 (0.36)	1.74 (0.51)	>0.001
Tidal Volume(litres)	0.46 (0.13)	0.52 (0.19)	0.054
Minute Ventilation(l/minutes)	12.16 (6.41)	14.87 (5.65)	0.042
Breathing Frequency (breaths/minutes)	18.15(9.82)	19.87 (6.24)	0.009*
TI(time of inspiration in seconds)	1.23 (0.75)	0.78 (0.91)	0.034*

- P<0.05, mean difference between the groups (mean±SD) is statistically significant

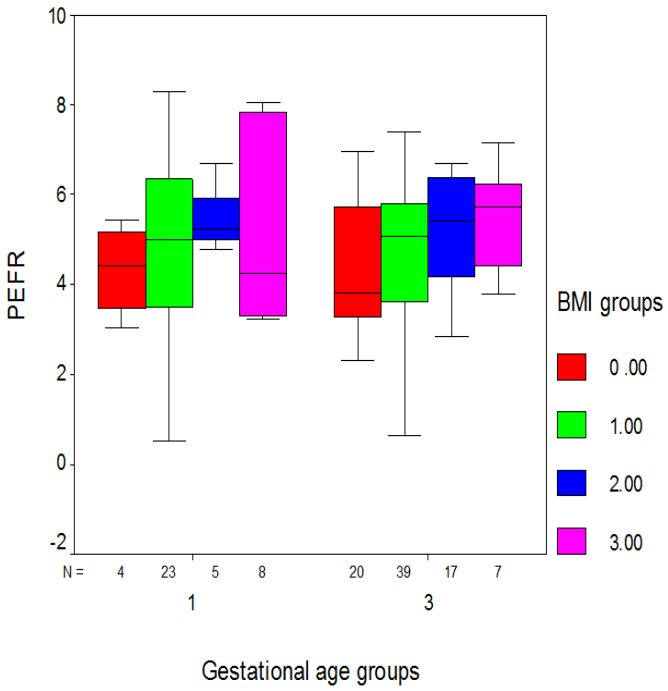

Figure 1: A linear positive correlation between maternal gestational age and PEFR in pregnant women both in the first and third trimester.

Table 6: Measured SaO_2 and pulse rate according to the trimester of pregnancy compared.

Parameters	1st trimester	3rd tri-	p-value	Pearson correlation
	Mean (SD)	Mean (SD)		
	95.15 (1.59)	95.33(1.89)	0.613	0.046
Pulse rate (beats/minutes)	88.73(12.48)	93.60(9.13)	<0.001	0.367*

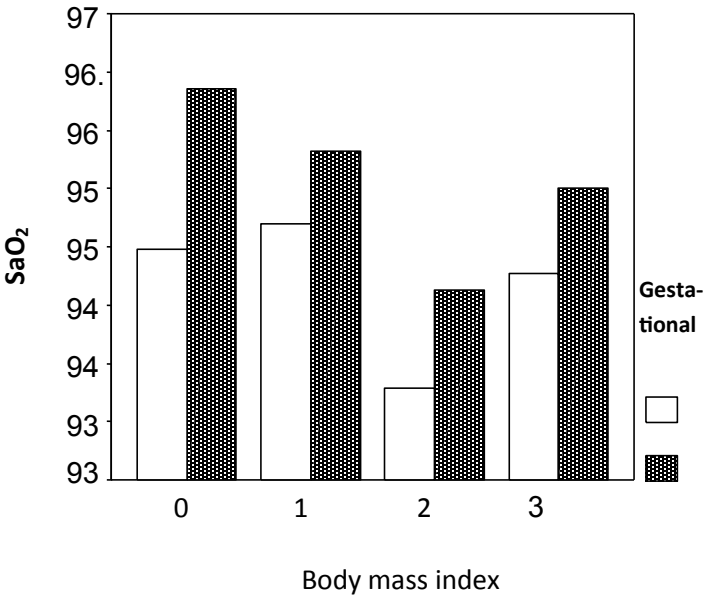

Figure 2: Percentage of SaO_2 in the first and third trimesters in each BMI class

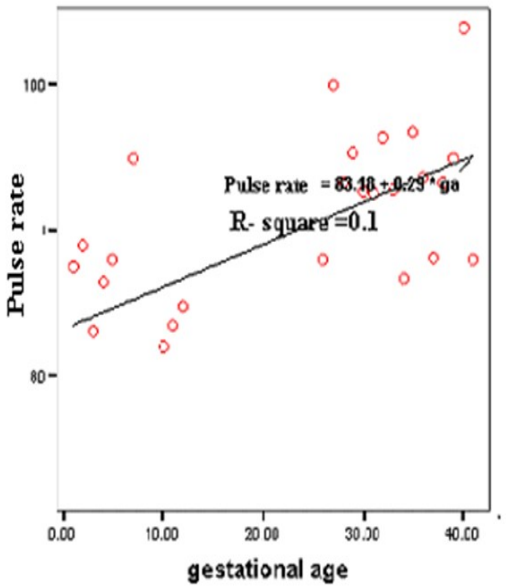

Figure 3. Regression line of pulse rate when gestational ages progresses

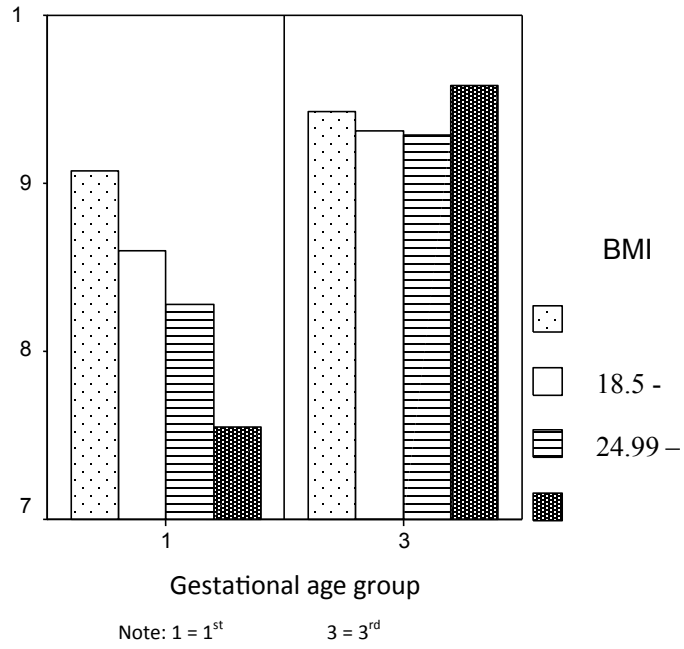

Figure 4: comparison of mean pulse rate between the 1st & 3rd trimester groups as classified in each body mass group.

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A CASE REPORT: USE OF FETAL MRI IN DIAGNOSIS OF FETAL BILATERAL RENAL AGENESIS

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ABSTRACT

OBJECTIVE: The aim of this case report is to show the use of fetal MRI in the diagnosis of fetal anomalies when ultrasound is inconclusive. As most clinicians and radiologists are not familiar with fetal MRI we thought this case report may be useful as an eye-opener to the imaging modality. This is the first case of fetal MRI in Ethiopian setting to the best of our knowledge.

CASE SUMMARY

We report a case of a 27-year-old primigravida mother who came for antenatal care to Myungsang medical center at gestational age of 23weeks. Our initial ultrasound made a diagnosis of a hydramnios, otherwise actively moving fetus. Fetal anatomical scanning by ultrasound failed to make a proper diagnosis. We sent for fetal MRI where the diagnosis of fetal bilateral renal agenesis was made. Random blood sugar of the mother and oral glucose tolerance test were found to be normal. We counseled the family for pregnancy termination and they agreed. Pregnancy was terminated at 24 weeks and autopsy confirmed the diagnosis.

(Ethiopian Journal of Reproductive Health 2016; 8:45-49)

CASE SUMMARY

History:

A 27 years old primigravid mother came to our hospital on June 10/2015 at gestational age of 23 weeks. She felt fetal movement a week before her presentation. She doesn't remember her LNMP. The pregnancy is planned and wanted .She is married and house wife. She has no history of diabetes mellitus or other medical illnesses. She has no history of alcohol or drug abuse. She came for antenatal care. It was her first visit.

There is no leakage of watery fluid per vaginum or discharge. There was no fever, chills or rigors. There was no history of herbal medications. No family history of congenital anomalies.

PHYSICAL EXAM

BP: 100/60mmhg PR: 77/min T: 36 c, Height; 165Cms, Weight: 62kgs

Pink conjunctiva and non-icteric sclera

No significant Lymphadenopathy or thyroid swelling.

No lumps in the breasts.

Chest: Clear

CVS: No murmurs or gallop

Abdomen: No hepatosplenomegaly, 22weeks gravid uterus, FHR 158BPM.

No area of tenderness

Kidneys are not palpable, no Costovertebral angle tenderness Speculum examination: No pooling of amniotic fluid on posterior fornix/blade. No leakage from cervical os on valsalva maneuver.

Ferning test was negative

Lab data, ultrasound and MRI result

HIV : Neg, VDRL: NR, HBsAg: Neg. Hemoglobin 13gm/dl, OGTT :FBS 77mg%,1st hour 123mg%,2nd hour 98mg%,3rd hour 83mg%

Fetal ultrasound: anhydramnios (complete absence of amniotic fluid) and gestational age 23weeks. Difficult to do anatomic survey as there was no acoustic window. The detailed anatomic survey couldn't pick any other fetal abnormalities. Bladder was not visualized. Lying down adrenal signs were not detected bilaterally. Bowel occupied the area of renal fossae .The chest circumference was lower than abdominal circumference by 45%, which indicates pulmonary hypoplasia.

Option of amnioinfusion for fetal sonographic survey was offered to the mother and she opted for fetal MRI.

Fetal MRI: Mother was sedated by diazepam 10mg IV slowly before MRI to decrease the fetal movement. Contrast was not used. The result showed absent bilateral kidneys. No other anomalies identified.

Treatment and outcome: The mother was counseled about the prognosis. She was counseled for termination of the pregnancy. She agreed .Labor was induced by misoprostol 200microgram.and she expelled after 2doses .The fetus was alive weighing 650gram.It died few minutes after expulsion. It was sent to autopsy and the autopsy result confirmed the fetal bilateral renal agenesis. Both the father and mother were scanned for renal problem and they were found to be normal. She was told to come back for preconception counseling when she plans to become pregnant.

Figure 1.Absent fetal kidneys in transverse view

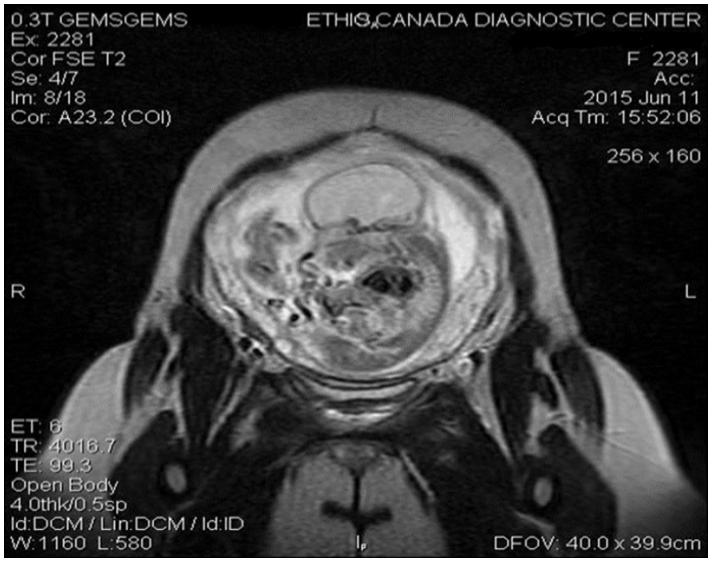

Fig 2: Absent fetal kidneys in mid-sagittal view

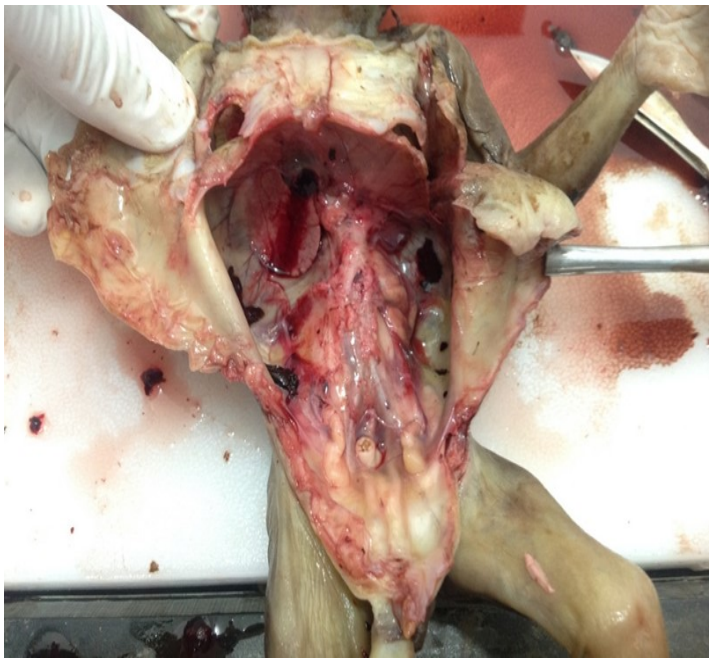

Fig 3: Absent kidneys, ureter and bladder

head circm23cms,CRL20cms, fetal wt 650g,placental wt214g,cordlength20cms syndrome)

DISCUSSION

Undoubtedly, Ultrasonography (USG) is an ideal imaging procedure during pregnancy. It is noninvasive, inexpensive, with no radiation risk and provides an opportunity to visualize the fetus. Sometimes ultrasound examination might be hampered by maternal obesity, oligo/anhydramnios, fetal position and reverberation caused by bones. When USG is unable to provide a definitive diagnosis, further investigation with more sophisticated methods is necessary. One of these methods is magnetic resonance imaging (MRI), which plays an increasingly important role in fetal visualization. MRI of a human fetus was first described in 1983 [1]. Initial attempts to use MRI in

obstetrics were limited by fetal movement, despite pharmacological immobilization of the fetus [2,3]. Currently, the use of direct fetal paralysis is strongly discouraged.

Some authors recommend pre-procedure maternal sedation in order to decrease fetal movements [4]. Though MRI gives detailed information about the fetus it is more expensive and not portable. It is less available but it is operator independent. The administration of contrast media during pregnancy is still controversial. Gadolinium, which is classified as a category C drug by the Federal Drug Administration (FDA), crosses the placenta, and is excreted by the fetal kidneys into the amniotic fluid. The recommendations of the American College of Radiology Guidance-Document for safe MR practices state that intravenous gadolinium administration should be avoided during pregnancy [5].

Through its superior soft tissue contrast resolution, MRI is able to distinguish individual fetal structures such as lung, liver, kidney, and bowel [6]. Fetal MRI is useful in all fetal organ system, but its superiority is seen in fetal CNS as calvarium cannot obscure the image unlike ultrasound [7].

Renal agenesis may be either unilateral or bilateral. Bilateral renal agenesis is incompatible with extra uterine life because prolonged absence of amniotic fluid results in pulmonary hyperplasia leading to severe respiratory insufficiency at birth. The longest-surviving child lived 39 days [8].

Renal agenesis is due to either never developed from outset or due to regression of cystic kidneys. Bilateral renal agenesis is uncommon prenatal diagnosis with an incidence of 1:10,000. It is a lethal anomaly with 50% of the fetus being stillborn. The rest would die shortly after birth, due to severe pulmonary hypoplasia [9]. It is also associated with many other congenital anomalies including skeletal, genitourinary, tracheoesophageal and brain anomalies, many of which have autosomal dominant or recessive inheritance. Therefore, the risk of such anomalies in the subsequent pregnancy is also increased [10].

It is usually sporadic in nature, but may present with a familial history. It is associated with maternal diabetes [11]. It results from a lack of induction of the metanephric blastema by the ureteral bud. Newborns with bilateral renal agenesis have low-set floppy ears, broad, flat nose, redundant and dehydrated skin, wide set eyes, prominent fold arising at the inner canthus of each eye, parrot beak nose and receding chin. These features are known as Potter's facies [12].

CONCLUSION

Antenatal diagnosis of bilateral renal agenesis is uncommon although important. It is a lethal anomaly with 50% of the fetuses being stillborn and the rest would die shortly after birth, due to severe pulmonary hypoplasia. In a woman who has anhydramnios diagnostic amnioinfusion can be tried to create acoustic window for detailed fetal anatomic survey. If that is impossible because of mother's unwillingness (as in our case) or other reason fetal MRI can be done to make final diagnosis.

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A Case of Bilateral Craniofacial Cleft From Amniotic Band Syndrome

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Amniotic band syndrome [ABS] or amniotic disruption complex is defined as a destructive process of fetal damage in a random non symmetrical distribution, which is not attributable to aberrations in normal embryologic development processes .The mechanism has been considered to be initiated in rupture of the amnion, with the fetus then coming into contact with the chorionic surface of the amniotic membrane ,to which it adheres or becomes entwined by fibrous strands .As the fetus grows ,The tethered regions are progressively distorted, leading to constrictions, amputations ,Slash defects, and body wall or cranial defects .The severity varies from a single constrictive ring of a digit to lethal thoraco abdominal eviscerations or craniofacial distruction.ABS is a rare disorder in which bands of mesoderm that emanate from the chorionic side of the amnion and insert on the fetal body can lead to a wide variety of disfiguring and disabling malformations[1,2].

ABS results in the amputation of the fingers or limbs, associated with a wide spectrum of congenital anomalies usually involving the trunk and craniofacial regions including the skull. AbBS is in general sporadic and the incidence is approximately 1 in 15,000 live birth. Characterized by a destructive fetal process that is initiated by rupture of the amnion. Proposed as a sequel of intrauterine rupture of the amnion resulting in oligohydramnios and passage of fetus to chorionic cavity .The fetus subsequently becomes adherent to intertwined in, and tethered by fibrous mesodermic bands .As the fetus grows, its anatomy is distorted .This may lead to cranial or body wall defects or and although been reports of associated malformations of internal structures. [3, 4]

ABS that involves craniofacial region may present as cleft lip or palate , oblique or transverse facial cleft .These craniofacial anomalies in ABS are typically often bizarre and frequently non-embryological .The exact cause of ABS is still unknown .This lack of direct evidence has led to the proposal of two main etiological theories. The extrinsic and the intrinsic 4. The extrinsic theory states that the band of ruptured amnion causes an extrinsic compression which then results in constriction rings and other deformities of the developing fetus, while the intrinsic theory holds that germ cell deficiencies result in the malformation of the affected parts [4]. Treatment is usually carried out after birth when plastic and reconstructive surgery is considered to treat the resulting deformities. [4, 5]

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DISCUSSION

We present a case of bilateral transverse facial cleft and cranial bone defect born to a 28 year old gravida 4 para 1 mother delivered by C/S at gestational age of 41 weeks and 2 days with the indication of prolonged active first stage of labor and previous C/S scar. The pregnancy had otherwise been clinically uneventful till delivery of this female neonate weight 3120 grams with APGAR score of 8/10 in first and 9/10 in 5th minutes having stated malformations.

And the neonate cannot feed either with breast feeding or bottle due to sever bilateral transverse facial defect. On gross examination neither skeletal nor soft tissue anomalies seen except the stated cranio facial defect. X-ray of the skull shows bone defect at basal skull ,U/S examination of internal organs – normal, U/S examination of brain normal ,CT-scan of brain also showed normal finding. Neonate kept with NG-tube feeding after several attempt to have reconstructive surgery to be done for the neonate, contact made to plastic surgery and anesthesiologist was tried. After 3-4 weeks of NG feeding soft tissue defect repaired and the baby is currently in good condition and able to feed maternal breast and gaining weight with normal developmental mile stones.

Various mechanisms for the development of amniotic disruption complex have been reviewed by seeds and co-workers. Contemporary views largely favor the exogenous theory proposed by Torpin, which spontaneous rupture of the amnion leads to. ABS is a known case fetal malformations and the anomalies range from mild to sever ones that may be incompatible with post-natal life.

The exact incidence is unknown but, reported series suggest that they occur in between1 in 12,000 and 1 in 15,000 live birth and are commoner in the early pregnancy .The findings in this case are strongly consistent with ABS.

We report a case in which an initially normally formed fetus has subsequently developed an anatomic deforming attributable to this condition. Various mechanisms for the development of amniotic disruption complex have been reviewed by seeds and co-workers[5]. Contemporary views largely favor the exogenous theory proposed by Torpin that spontaneous rupture of the amnion leads to failure of further growth of the amniotic sac. According to the extrinsic theory in the etiology of ABS, the distribution of the amnion allows the embryo or fetus to enter the chorionic cavity and contact the chorionic side of the amnion. Fetal parts may then become interrupted by the fibrous septum that traverse the chorionic space. [5]

The entanglement of fetal parts is random and the slash defects so created are non-embryologic in distribution. Fetal band and clefts could be a result of local compression or adhesion. Therefore the present case report may further support the concept of extrinsic theory in the etiology of ABS. The severity of the

band compression on the developing fetus could determine morphology of the deformity. Although severe craniofacial cleft caused by ABS are often incompatible with life, a number of these children may still survive even till school age with the accompanying facial anomaly. It has been observed that the preference of amniotic bands in consumption with craniofacial cleft is part of clinical futures of this syndrome [5, 6].

To the best of our knowledge, this is the first case to be presented in our region [ETHIOPIA].

The corrective surgical procedures for patients with ABS may range from minor to complex, and the outcome depends on the severity of the deformations [6]. The presence of a fibrous band at the base of facial cleft and scalp of this neonate suggests that ABS may be the primary cause of this defect, probably by slash effect [7]. The presented case with peculiar features of craniofacial cleft support the ideas that deformity is likely related to ABS.

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