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Original Research Article

Prospective analytical study on acute pulmonary edema in obstetric intensive care unit

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ABSTRACT

Background: Acute pulmonary oedema is an uncommon, but life threatening event in pregnancy. It causes significant morbidity and mortality due to pathophysiology of pre-eclampsia and physiological changes of pregnancy which may aggravate certain pre-existing heart disease.

Methods: This study was conducted to describe the clinical and epidemiological profile of antenatal women with acute pulmonary edema in obstetric ICU from January 2017 to December 2018 (2 years) in Mahathma Gandhi Memorial Government Hospital, Trichy, Tamil Nadu, India.

Results: Acute pulmonary edema (n=31) accounts for 2.7% of ICU/HDU admissions in the study period. Most common etiology observed was severe preeclampsia (12 cases) followed by cardiogenic pulmonary edema (11 cases). Fluid overload, sepsis accounted for 7 cases and one mother with preexisting RHD had severe pre-eclampsia with acute pulmonary edema.

Conclusions: Hypertensive disorders of pregnancy and heart disease contributes to major proportion of acute pulmonary edema in this study and it is imperative to recognize signs of critical illness. Skilled multidisciplinary teamwork plays an important role in optimizing maternal and fetal health.

Keywords: Acute pulmonary edema, Heart disease, Severe preeclampsia

INTRODUCTION

Pulmonary edema is defined as the accumulation of fluid in the pulmonary interstitial spaces and alveoli, which prevents the adequate diffusion of both oxygen and carbon dioxide.¹ It is an acute respiratory event occurring in pregnancy or within 42 days of delivery, diagnosed by the presence of sudden-onset or progressive dyspnea, orthopnea with decreased saturation and lung signs.

Physiologic changes such as decrease in colloid osmotic pressure, increase in blood volume and decrease in functional residual capacity increases propensity for pulmonary edema in pregnancy. The clinical setting in

which pulmonary edema can occur in pregnancy are tocolytic therapy, preeclampsia, cardiac disease, sepsis, renal failure, very severe anemia, intracranial haemorrhage, amniotic fluid embolism or may be multifactorial.² The main mechanism of sepsis related pulmonary edema may be due to increased sensitivity of pregnant women to bacterial endotoxin, which increases pulmonary capillary permeability. Endothelial activation is the main denominator in pre-eclampsia and sepsis syndrome.³

The commonest cause of cardiogenic pulmonary edema in pregnancy is rheumatic mitral stenosis and it occurs mostly in post-partum period. The postpartum period can

be characterized as a “perfect storm” of volume loading, tachycardia, and increased afterload; each of these may contribute to the destabilization of a pregnant woman with heart disease.⁴

Echocardiography should be an integral part of the initial evaluation of the etiology and management of acute pulmonary edema in pregnancy.⁵ Initial management constitutes semi Fowlers position, oxygen, frusemide, non-invasive positive pressure ventilation. Intubation and mechanical ventilation may be required for refractory hypoxemia. In severe pre-eclampsia, control of hypertension with intravenous labetalol and termination of pregnancy if the mother is in antepartum period is done. In severe sepsis, appropriate antibiotics and supportive care needs to be given.

METHODS

In this study, antenatal women with acute pulmonary edema as described by clinical features above were included. Demographic data, investigations, maternal and perinatal outcome were studied.

Inclusion criteria

- Mother admitted with features of acute pulmonary edema in ICU/HDU. (Sudden onset dyspnea, orthopnea, decreased oxygen saturation, lung signs).

Exclusion criteria

- Acute severe asthma
- Pulmonary tuberculosis
- Restrictive lung disease
- Community acquired pneumonia
- Transfusion reaction.

This study was conducted from January 2017 to December 2018 (2 years). Department of Obstetrics and Gynaecology, Mahathma Gandhi Memorial Government Hospital, Trichy, Tamil Nadu, India.

Women admitted with features of acute pulmonary edema were all included in this study. Demographic details like age, parity, obstetric code, booking status and socio economic status were recorded. Presence of co-morbid conditions such as anemia, severe pre-eclampsia, chronic hypertension, asthma, pulmonary tuberculosis, thyroid disorders and history of blood transfusion were collected. Details of basic investigations, chest x-ray were collected. Echocardiographic assessment of cardiac function was noted. Details about period of occurrence of pulmonary edema, fluid management and treatment given such as diuretics, antihypertensives, ventilator support, mode of delivery and period of ICU stay were collected. Outcome analysis including maternal and perinatal outcome were done. Data were tabulated and analysed for results.

Statistical analysis

Statistical analysis was done using SPSS 26 software.

RESULTS

In this study, we had 31 cases of acute pulmonary edema among 18,958 deliveries which equates to 16 cases/10,000 deliveries. It contributed to 2.73% of ICU/HDU admissions (Figure 1).

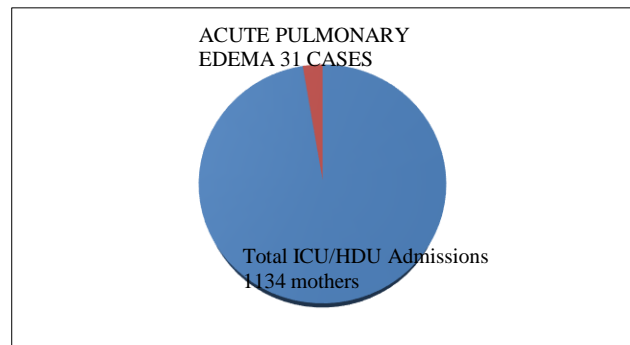


Figure 1: Contribution of acute pulmonary edema to obstetric ICU/HDU admissions.

Table1: Causes for acute pulmonary edema.

Causes	Number of cases
Hypertensive disorders of pregnancy	12 (38.7%)
Heart disease	11(35.4%)
Heart disease and severe preeclampsia	1 (3.2%)
Sepsis	5 (16%)
Fluid overload	2 (6.4%)

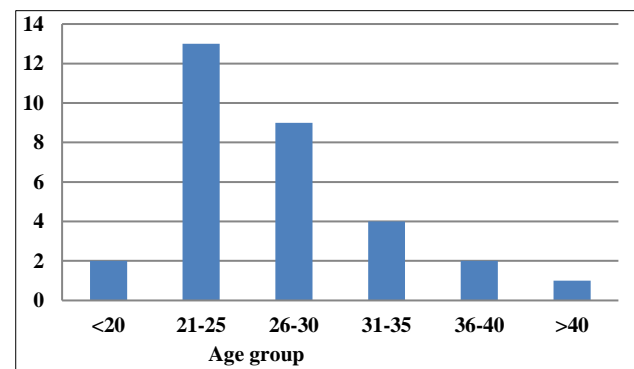


Figure 2: Age wise distribution of pulmonary edema cases.

Hypertensive disorders of pregnancy and heart disease were major contributors to acute pulmonary edema accounting for 74% of cases. Fluid overload and sepsis accounted for rest of the cases (Table 1). Acute pulmonary edema due to fluid overload was minimal due to regular auditing of maternal death and emphasis on strict fluid management in hypertensive disorders of

pregnancy. Tocolytic induced pulmonary edema was not encountered in this study as we use nifedepine for tocolysis for short period.

77.4% of cases occurred in age group less than 30 years (Figure 2). Severe pre-eclampsia culminating in acute pulmonary edema was observed in extremes of age group less than 20 (n=2) and more than 40 years (n=1).

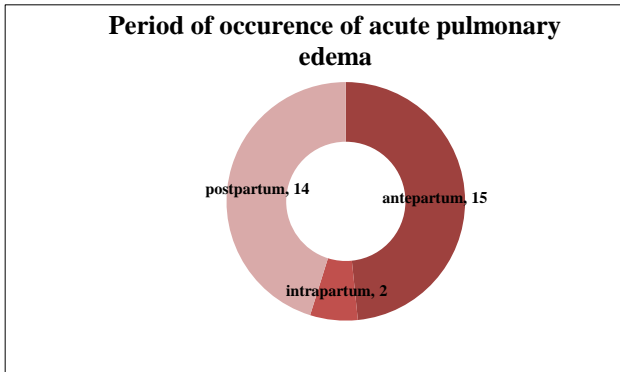


Figure 3: Distribution of acute pulmonary edema as per period of occurrence.

48.3% of cases occurred in antepartum period and 45% in postpartum period. Intrapartum occurrence (6.4%) of acute pulmonary edema was a rare event. (Figure 3) Severe preeclampsia presented invariably in antepartum period and mostly in young primigravida. In this study, among women with severe pre-eclampsia, one had twin pregnancy and in those with cardiogenic pulmonary edema, all were singleton pregnancies. Heart disease particularly, rheumatic heart disease, mitral stenosis accounted for acute pulmonary edema postpartum, especially within 24 hours after delivery and this may be explained by auto transfusion from postpartum uterus.

The most common mode of delivery was caesarean section in 48.3% (15 mothers), followed by labour natural in 35.4% (11 mothers) and instrumental delivery in 13% (4 mothers). Caesarean section was the mode of delivery in most cases because of necessity for termination of pregnancy with unfavourable cervix in a short time. One mother with rheumatic mitral stenosis had spontaneous miscarriage at 18 weeks of gestation.

Preterm delivery was commonest in 58% of cases (9 mothers before 34 weeks, 9 mothers before 37 weeks) and 38.7% of mothers delivered after 37 weeks. IUD was noted in 2 cases. NICU admission rate was 22%. The most common reason was respiratory distress due to prematurity followed by perinatal asphyxia.

After clinical recognition of acute pulmonary edema, it is imperative to ascertain the etiology which is essential to institute specific treatment. Doppler echocardiography permits systolic and diastolic evaluation, differentiating cases of cardiogenic from those of noncardiogenic pulmonary edema.

In this study, antenatal mothers can be classified as acute pulmonary edema associated with hypertension and those without hypertension. In acute pulmonary edema secondary to hypertensive disorders of pregnancy, echocardiography was normal in 6 cases, systolic dysfunction was observed in 5 cases, diastolic dysfunction in 1 case of chronic hypertension (Table2).

Table 2: Echocardiographic features in acute pulmonary edema with hypertension.

Echocardiographic findings	Number of cases
Normal study	6
Systolic dysfunction	5
Diastolic dysfunction	1
RHD- Moderate mitral stenosis with severe preeclampsia	1

Table 3: Echocardiographic features in women with acute pulmonary edema without hypertension (Cardiogenic pulmonary edema).

Echocardiographic findings	Number of cases
Rheumatic mitral stenosis	6
Rheumatic mitral stenosis with regurgitation	3
Peripartum cardiomyopathy	2
RHD-mitral stenosis with severe preeclampsia	1

In acute pulmonary edema without hypertension, severe rheumatic mitral stenosis was observed in 6 cases, (Table 3). Mitral stenosis with regurgitation was noted in 3 cases, peripartum cardiomyopathy in 2 cases. One mother had severe preeclampsia and pre-existing rheumatic mitral stenosis. Echocardiography was normal in 3 cases of sepsis and showed systolic dysfunction in 2 cases. In 2 cases of pulmonary edema due to fluid overload, normal echocardiographic findings was observed.

Pre-eclampsia is an important cause of acute pulmonary edema associated with hypertension. Immediate management includes oxygenation, ventilation, frusemide administration, control of hypertension with intravenous labetalol, nitroglycerin. In this study, mechanical ventilation was needed in 45.5% of cases, non-invasive ventilation in 25.5%, high-flow oxygen therapy in 29% of cases (Table 4).

Table 4: The need for type of oxygen therapy.

Type of oxygen therapy	Number of cases
High flow oxygen therapy	9 (29%)
Non-invasive ventilation	8 (25.5%)
Mechanical ventilation	14 (45.5%)

In acute pulmonary edema associated with severe preeclampsia (n=13), 9 mothers recovered, and three maternal deaths occurred. On analysis of maternal death,

two mothers were referred antenatally with acute pulmonary edema in a moribund state (Figure 4), resuscitated, termination of pregnancy done by caesarean section and one of them succumbed early and another woman had intra-cerebral haemorrhage and died after 2 days of ICU stay. Early referral of antenatal women with severe preeclampsia, education about warning symptoms, prompt control of hypertension are important measures to curtail maternal mortality and morbidity in hypertensive disorders of pregnancy (Table 5).

In acute pulmonary edema without hypertension, 13 mothers recovered, and 4 maternal deaths occurred. 2 deaths were due to rheumatic mitral stenosis (severe), and one of them had right atrial clot and was on anticoagulation. In both the cases, heart disease was undiagnosed until they presented in post-partum period with acute pulmonary edema. Proper antenatal history taking, meticulous clinical and obstetric examination, cardiologist consultation whenever necessary and echocardiographic evaluation in suspected cases goes a long way in evading maternal mortality and morbidity in

those cases. 2 mothers died due to MODS and sepsis, primary event being septic abortion in one mother and scrub typhus in the other.

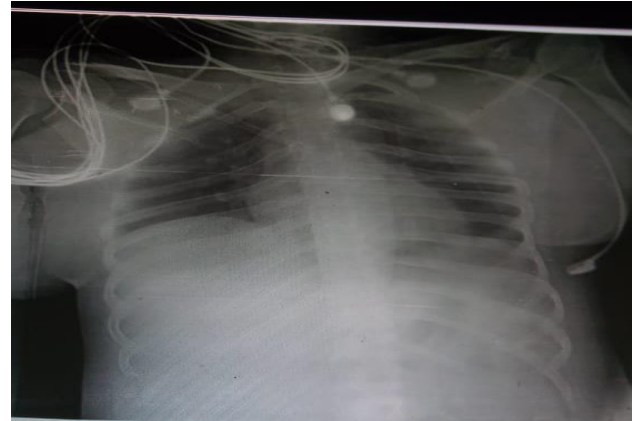


Figure 4: Bedside chest x ray of mother with acute pulmonary edema with severe pre-eclampsia.

Table 5: Maternal outcome in women with acute pulmonary edema.

Maternal outcome	Acute pulmonary edema with hypertension (n=13)	Acute pulmonary edema without hypertension (n=18)
Recovered and discharged in stable condition	9	13
Maternal death	3	4
Discharged with morbidity	1	1

DISCUSSION

In the study period, we had 31 cases of acute pulmonary edema among 18,958 deliveries which equates to 16 cases/ 10,000 deliveries. It contributed to 2.73% of ICU/HDU admissions. This is higher than the prevalence 8/10,000 deliveries quoted in study by Scisione et al and this may be attributed to referral from peripheral hospitals.⁶ The Scottish confidential audit of severe maternal morbidity, one of the largest maternal morbidity audits, reported that acute pulmonary oedema was the fourth most common form of maternal morbidity. It is also frequently the reason for intensive care admission.⁷

The main causes quoted were tocolytic agent, heart disease, severe pre-eclampsia and fluid overload.⁸ In case series study of acute pulmonary edema by Pordeus et al, it occurred commonly in antepartum period and was associated with hypertension.⁹ Fluid overload appeared to constitute an important trigger. In case control study of pulmonary edema in severe pre-eclampsia in Indonesian referral hospital, 5.6% of those with severe pre-eclampsia had pulmonary edema. Postpartum occurrence was common and around 60% needed mechanical ventilation.¹⁰ In pulmonary edema and pre-eclampsia study (PEPE), 92 women with preeclampsia were

studied, of which 28 women developed pulmonary edema and half of them occurred in antepartum period.¹¹ In present study, antepartum occurrence (48.5%) of pulmonary edema was common followed by postpartum (45%) and intrapartum events. In our institution, tocolytic use is not a common cause of acute pulmonary edema, as we use nifedipine as tocolytic for a short period and beta mimetic agents are not used for tocolysis. Severe pre-eclampsia and heart disease were important causes of acute pulmonary edema in pregnancy in present study.

78.5% of women were delivered by caesarean section in study by Pordeus et al and in our study also, 48.3% of women were delivered by caesarean section. Caesarean section was the common mode of delivery due to necessity to terminate pregnancy with unfavourable Bishops score in a short period of time. Similar results were observed in a cross sectional study of 118 mothers with acute pulmonary edema, hospitalised in ICU with hypertension done by LeilaKatz et al.¹²

In case series study of acute pulmonary edema by Pordeus et al, 18% of patients diagnosed with valvular heart disease were unaware of the presence of heart disease and all the patients with structural disease diagnosed during the episode of acute pulmonary edema

had rheumatic heart disease. In present study also, two mothers were diagnosed to have heart disease only after they presented with acute pulmonary edema. Whenever antenatal woman presents with acute pulmonary edema, it is imperative that she undergoes echocardiography.

In study by Scissone et al, preeclampsia was the cause of pulmonary edema in 17.4% of patients and they are at an increased risk for the development of pulmonary edema due to underlying endothelial damage and decreased colloid osmotic pressure, which cause leakage into the pulmonary interstitium or alveolar space. Combined with the left ventricular dysfunction and increase in peripheral vascular resistance, pulmonary edema develops. The development of pulmonary edema appears to be influenced by several factors including maternal age, parity. In our study also, pre-eclampsia accounted for 42% of acute pulmonary edema admissions and among them 70% recovered and among 30% (n=3), two were admitted in a moribund state and one died due to intracerebral haemorrhage.

CONCLUSION

Acute pulmonary edema in pregnancy, though rare is important contributor to maternal morbidity and mortality. Risk reduction strategies include.

- Proper antenatal care with keen recognition of symptoms and signs of heart disease, pre-eclampsia
- Prompt control of hypertension in mothers with severe pre-eclampsia
- Timely consultation with cardiologist and deciding plan of management in women with heart disease
- Strict fluid balance in mothers with pre-eclampsia and heart disease.

Use of echocardiography helps in defining the aetiology of acute pulmonary edema and deciding plan of management. Prompt recognition of signs of critical illness, institution of specific therapy by a skilled multidisciplinary team is imperative in optimizing maternal and perinatal outcome in acute pulmonary edema. Obstetricians should be equipped with basic principles and technique of critical care in order to manage these cases and also to give expert opinion the critical care team.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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