A Retrospective Evaluation of Obstetric Patients Admitted to the Intensive Care Unit: Has Anything Changed in the New Era of Technology?

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ABSTRACT

Objective: Despite the fact that obstetric cases constitute only a small portion of intensive care hospitalizations, maternal mortality still remains an important health problem in the world. In this study, we aimed to evaluate the frequency and reasons of admission of obstetric patients to the intensive care unit (ICU), as well as the ‘advanced’ treatments applied and the clinical outcomes.

Materials and Methods: The medical records of 8800 obstetric patients who were admitted to the hospital between 2012-2017 were retrospectively reviewed. The demographic data, reasons for admission to the ICU, concomitant diseases, intensive care interventions (advanced monitoring, extracorporeal therapies, etc.) and clinical outcomes were evaluated.

Results: Of the 8800 obstetric patients, 40 (0.45%) patients required intensive care. The mean age was 32.2±5 years. The mean duration of stay in the ICU was 4.3 days. The most common reasons for admission to the ICU were HELLP-Preeclampsia-Eclampsia in 16 (40%) patients and bleeding (due to disseminated intravascular coagulation, uterine perforation, uterine atonia) in 11 (27%) patients. Seventeen patients received invasive mechanical ventilation and 3 patients received non-invasive mechanical ventilation. Two patients received extracorporeal membrane oxygenation (ECMO), 4 patients received plasmapheresis and 5 patients received hemodiafiltration. Three patients died. One patient died of multiorgan failure secondary to HELLP (hemolysis, elevated liver enzymes, and low platelets) syndrome. Two patients died due to HELLP and intracerebral hemorrhage. Conclusion: Advanced intensive care settings where new-era technological equipment (ECMO, hemodiafiltration, advanced monitoring, etc.) is in-reach and employing a multidisciplinary approach in the ICU may decrease the maternal mortality and morbidity.

Keywords: Obstetric patients, ICU, Technology

1. INTRODUCTION

Since pregnant women are often young and healthy, maternal death is a tragic event. Despite the therapeutic advancements of the 21st century, maternal mortality remains an important public health problem [1,2]. The incidence of admission of obstetric patients into the intensive care unit (ICU) is 7-13.5 per 1000 live births [3,4]. Patients may be transferred to the ICU for both obstetric and non-obstetric indications. The most common causes are hypertensive disorders of pregnancy and obstetric hemorrhages [4]. Acute respiratory failure requiring mechanical ventilation is a rare complication during pregnancy, with an incidence of 0.1-0.2 % [4,5]. Although obstetric patients constitute a
small portion of ICU admissions, the likelihood of disastrous outcomes is high in these patients given their complicated clinical conditions [6]. The new era of technology has contributed a lot to the intensive care concept and infrastructure. Despite the advancements in intensive care medicine, maternal mortality and morbidity still remain high. This is probably due to obstetric causes and concomitant diseases [5,7]. The overall maternal mortality rate in the ICU ranges from 3.4% to 21% [3].

ICUs are special treatment units that are designed for the follow-up and treatment of life-threatening organ insufficiencies arising during acute or chronic illnesses, in which the number of health professionals per patient is high in order to provide close monitoring and rapid intervention. The medical equipment used in ICUs are getting more and more advanced than before. The care provided in the ICU has an important role in the early recognition of complications and in the healing process. Therefore, ICU admission is recommended for critically ill obstetric patients. In Turkey and in many developing countries, patients with pregnancy-related complications are treated in the wards or in the ICUs. There are no ICUs specified for obstetric patients. The aim of this study was to retrospectively evaluate obstetric patients treated in a fully-equipped tertiary intensive care in terms of reasons for admission and whether the advanced management of these patients has ever changed the clinical outcomes or not.

2. METHODS

After Ethics Committee approval was obtained, the medical records of obstetric 8800 patients who were hospitalized for obstetric causes in an Education and Research Hospital between June 2012 and June 2017, were retrospectively reviewed for patients who were admitted to the ICU. With informed consent, 40 eligible patients were included in the study. The maternal age, gestational age, type of delivery, concomitant diseases, admission diagnosis, and Glasgow Coma Score (GCS) at ICU admission were recorded. The Acute Physiology and Chronic Health Assessment Scores (APACHE) II, the Sequential Organ Failure Assessment scores (SOFA), the Simplified Acute Physiologic Scores (SAPS 3) were reviewed and the highest scores were recorded. Severe illnesses (HELLP, hemorrhage, preeclampsia/eclampsia, infection, heart disease, asthma, etc.) that caused the patients to be transferred to the intensive care unit, concomitant diseases, complications, and infections developed during ICU stay were recorded. The duration of stay in the ICU, invasive procedures performed (urinary catheterization, nasogastric catheterization, intubation, tracheostomy, central venous cannulation, arterial cannulation, advanced hemodynamic monitoring), blood and blood product transfusions (erythrocyte suspension, fresh frozen plasma, platelet suspension and cryoprecipitate), duration of invasive mechanical ventilation (IMV) and non-invasive mechanical ventilation (NIMV), hemodialfiltration, plasmapheresis, extracorporeal membrane oxygenation (ECMO), and vasoactive drug requirements (dopamine, dobutamine, noradrenaline etc.) were noted and evaluated. The patient outcome (discharge or death) and the cause of the death were recorded. Patients who developed acute respiratory distress syndrome (ARDS), multi-organ failure (MOF), disseminated intravascular coagulation (DIC) and sepsis during admission and/or treatment were recorded.

**Statistical analysis**

All statistical analyses were carried out using the MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013) program. Quantitative data (mean, standard deviation, minimum, median, maximum) were analyzed using descriptive statistics. Correlations between continuous variables with non-normal distribution were assessed using Spearman’s rho correlation analysis. A p-value less than 0.05 was considered statistically significant.

3. RESULTS

Of the 8800 patients who presented to our hospital, 40 (0.45%) were admitted to the ICU. The reasons for admission to the ICU are presented in Table 1.

**Table 1: Admission indications of the obstetric patients to the ICU**

<table>
<thead>
<tr>
<th>Reason for Admission</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>HELLP - Preeclampsia - Eclampsia</td>
<td>16 (40)</td>
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<tr>
<td>Bleeding (DIC, uterus perforation, uterine atonia)</td>
<td>11 (27)</td>
</tr>
<tr>
<td>Respiratory insufficiency (asthma, ARDS, pneumonia)</td>
<td>6 (15)</td>
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<tr>
<td>High cardiac risk (Mitral stenosis, cardiac insufficiency, Eisenmenger syndrome, hypertension)</td>
<td>5 (12)</td>
</tr>
<tr>
<td>Deteriorated general status (deceased fetus, thyrotoxicosis)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
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</table>
The mean duration of hospitalization was 4.6 days (range 1-40 days). The mean age of the patients was 31.5 years. Five patients were over 35 years of age. All patients were monitored with standard noninvasive devices and all patients received urinary catheterization. Invasive arterial monitoring was used in 33 patients, 25 patients underwent central venous pressure (CVP) catheterization, and advanced hemodynamic monitoring (PiCCO system, Pulsion Medical Systems, Munich, Germany) was used in 4 patients. Eighteen patients received blood and blood product transfusions.

In the ICU, 5 patients underwent hemodiafiltration, 4 patients underwent plasmapheresis, and 2 patients received ECMO. Three patients developed ARDS and sepsis, and 9 patients developed acute renal failure (ARF).

During their stay in the ICU, 8 patients (20%) required inotropic and vasoactive support for hemodynamic instability. Seventeen patients (42.5%) required invasive mechanical ventilation (IMV), 4 patients (10%) required non-invasive mechanical ventilation, and one patient (2.5%) required tracheostomy.

Concomitant diseases of the patients are presented in Table 2. Two patients underwent emergent surgery due to uterine rupture on the 16th week of pregnancy and were admitted to the ICU after the operation. One patient underwent emergent surgery due to placental detachment at the 23rd week of gestation and was admitted to the ICU after the operation.

<table>
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<tr>
<th>Table 2: Comorbidities and gestational age (gw)</th>
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<td>Asthma</td>
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In total, 2 patients received ECMO. One of these was admitted on the 16th week of gestation due to ARDS caused by Influenza A (H1N1) pneumonia. She received VV (venovenous)-ECMO for 13 days and IMV for 11 days. She was discharged without complications and later she delivered a healthy baby via cesarean section at term. The second patient was admitted to the ICU with a GCS of 8 on the 35th week of gestation. She developed cardiac arrest shortly after arrival and received 5 minutes of cardiopulmonary resuscitation (CPR). Further work-up revealed peripartum cardiomyopathy. VA (venoarterial)-ECMO was applied and the patient stayed in the ICU for 24 days (5 days on VA-ECMO). During this time, she also received hemodialfiltration due to ARF. She was discharged without sequelae.

A total of 5 patients received plasmapheresis. The first patient received plasmapheresis due to thyrotoxicosis on the 13th week of gestation. The second patient required plasmapheresis and hemodialfiltration due to DIC, ARF, sepsis, and intrahepatic cholestasis which developed after a cesarean section. She received 10 days of IMV and 2 days of NIMV. The third patient was admitted to the ICU with eclampsia and thrombotic thrombocytopenic purpura (TTP). She recovered after 5 days of plasmapheresis. The fourth patient had a history of Guillain Barre and she developed ARDS, ARF, and candidemia after a cesarean section. She stayed in the ICU for 40 days during which she received plasmapheresis and hemodialfiltration, and required tracheostomy due to prolonged mechanical ventilation (35 days).

A total of 3 patients died. The first patient was admitted to the ICU with a GCS of 3 on the 25th week of gestation. Fetal heart rate was positive. She received IMV for 3 days and died after cesarean section. The second patient, who had HELLP syndrome, developed an intracerebral hemorrhage during vaginal delivery. She died soon after being admitted to the ICU with a GCS of 3. The third patient was transferred to our hospital from another center with the diagnoses of HELLP, sepsis, ARDS, and ARF. She died within 24 hours of arrival.

A statistically significant positive correlation was found between the length of stay in the ICU and APACHE II, SAPS 3, and SOFA scores (Spearman’s rho; P<.05). A statistically significant negative correlation was found between the length of stay in the ICU and GCS on admission (Spearman’s rho; P<.05) (Table 3).

<table>
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<th>Table 3: Descriptive and correlation analysis of severity scores with length of stay (LOS)</th>
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<tr>
<td>LOS (days)</td>
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<tr>
<td>------------</td>
</tr>
<tr>
<td>0-40 (2)</td>
</tr>
<tr>
<td>Age (years)</td>
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<tr>
<td>r*</td>
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<tr>
<td>APACHE 2</td>
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<td>SAPS 3</td>
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In the present study, the mortality rate of patients admitted to the ICU with obstetric causes was found to be 7.5%. According to previous studies, the mortality rates of obstetric patients admitted to the ICU range between 0-20%, depending on the level of development of the country. Curiel-Balsera et al reported a maternal mortality rate of 1.5% in Spain [8], Cohen et al. reported a maternal mortality rate of 2.3% in Israel [9], Cheng and Raman reported a maternal mortality rate of 4.1% in Singapore [10], whereas Lapinsky et al reported zero mortality in Canada [11]. Unfortunately, developing countries have higher mortality rates compared to highly developed countries. In their retrospective series of 765 obstetric patients admitted to the ICU in India, Ashakiran et al reported a mortality rate of 15.5% [12]. In Turkey, maternal mortality rates were reported previously to be 10.4 % by Demirkiran et al.1 and 20 % by Simsek et al [2].

The mean age of patients in the present study was 31.5 years. In the study by Demirkiran et al, the mean age was 28±6 years [1]. On the other hand, the mean age was lower (25.5±5.6 years) in a study conducted in India by Karnad et al [13]. This might stem from the socioeconomic differences between countries. Early age of marriage and early childbearing in Asian countries such as India may be an important factor affecting mortality, whereas late marriages and late pregnancies in countries such as Australia pose different risks on the obstetric population due to advanced maternal age. In the present study, 12.5% of obstetric patients had advanced maternal age (>35 years).

The most common causes of ICU admission in the present study were preeclampsia/eclampsia plus HELLP (40%). The second most common causes were obstetric hemorrhages (27%). Other causes were respiratory distress (15%), high cardiac risk (12%) and deteriorated general condition (5%). In the literature, there are controversial results regarding this issue. In the 262-patient series by Curiel-Balsera et al, 78% of patients had severe preeclampsia, 16% of patients had HELLP syndrome and 6% had eclampsia. In the study by Demirkiran et al 73.6% of patients were admitted to the ICU with preeclampsia or eclampsia, whereas 11% were admitted with postpartum hemorrhage [1].

There are numerous studies in the literature in which the scoring systems developed for ICU patients were applied to obstetric patients. The APACHE II score, which provides objective information to assess the clinical condition and prognosis, is widely used. The present study also evaluated the GCS scores of the patients. A significant relationship was found between mortality and a GCS score lower than 8. In the study by Bhangwanjee et al. [14], GCS score was reported to be a good predictor of survival in ICU patients with eclampsia. It was also emphasized that in patients with eclampsia who have low GCS scores, it would be wise to monitor the neurological status closely.

In the present study, a statistically significant relationship was found between the duration of hospitalization and the highest values of APACHE II, SAPS 3 and SOFA scores of patients hospitalized for longer than 24 hours. Since the sample size of this study is very scarce, we could not determine the relationship between the scoring systems and mortality, because two of the patients who died were hospitalized for less than 24 hours, and the third died on the 4th day. In fact, the small sample size is the greatest limitation of this study.

Because complications such as hypertension and pulmonary edema are more frequent in obstetric patients, the need for invasive monitoring is higher in this patient group [15, 16, 17, 18]. The most commonly used invasive hemodynamic parameters in the ICU are CVP and mean arterial pressure. Close follow-up in the ICU with invasive monitoring accelerates recovery by helping in the timely detection of problems and by preventing complications [15]. In this study, 30 patients (75%) were monitored with a CVP catheter, 33 (82.5%) patients were monitored with an arterial catheter, and 4 patients were monitored with PiCCO. The purpose is to prevent the frequent complications such as pulmonary edema and heart failure, potential complications such as intracerebral hemorrhage, acute tubular or cortical necrosis, and even rare complications like retinal detachment, subcapsular liver hematoma or rupture. Among these, intracerebral hemorrhage is the most common cause of maternal mortality [18].

In the present study, 42.5% of patients required IMV, and 7.5% required NIMV. The need for mechanical ventilation was found to be similar to previous studies. Mechanical ventilation rates were reported as 40.6% in the study by Al-Suleiman et al [3], 42% in the study by Lapinsky et al [11], and 41% in the study by Cohen Suleiman et al [4].
et al [9]. The most common indications for mechanical ventilation were HELLP syndrome, acute respiratory failure, and hemodynamic instability. The incidence of ARF in preeclampsia has not been clarified [17,18]. The coexistence of eclampsia and HELLP syndrome with ARF is an important predictor of mortality. In fact, one study reported that the coexistence of HELLP syndrome and renal failure was associated with a 4-fold increased risk of mortality [18]. In our study, of the 9 patients who developed ARF, 5 required hemodiafiltration. Two of these patients had eclampsia. The other 3 patients required continuous renal replacement therapy due to DIC, sepsis and HELLP syndrome.

Plasmapheresis is a therapeutic intervention with various clinical applications. The main purpose of plasmapheresis is to eliminate plasma components such as antibodies, immune complexes and endogenous toxins. Plasma exchange has been shown to be helpful in patients with severe HELLP syndrome, by providing a rapid improvement in the platelet count and renal function tests [19]. In our study, 4 patients with complications such as HELLP syndrome, thyrotoxicosis, TTP and Guillian-Barre syndrome underwent plasmapheresis and successful outcomes were achieved in all patients. Due to the materials used in the procedure, plasmapheresis is still an expensive treatment modality. However, similar to our study, most studies have shown that plasmapheresis shortens ICU stay and reduces mortality. When performed under appropriate indications, ECMO is a treatment which may aid in the survival of critical patients who cannot maintain vital functions. It can be implemented as either veno-arterial (VA) or veno-venous (VV) therapy, depending on the clinical condition. Systemic venous blood from the patient is pumped into an oxygenator which acts as an artificial lung. The blood is oxygenated and cleared of carbon dioxide, and then pumped back into the patient’s arterial system via a pump which acts as an artificial heart. VV-ECMO is used for isolated respiratory failure, whereas VA-ECMO is used for cardiopulmonary failure. Compared to conventional therapies, ECMO yields better results in terms of survival [20, 21]. In the 2009 H1N1 pandemic, most patients receiving ECMO treatment due to severe ARDS were adults without any major heart diseases who received VV-ECMO [20]. In our study, 2 patients underwent ECMO. One of these patients had been referred to our hospital from another center with H1N1 pneumonia. After a successful VV-ECMO treatment, the patient was discharged with full recovery. The second patient underwent ECMO due to peripartum cardiomyopathy and cardiac arrest. After 5 minutes of CPR, due to intractable hypoperfusion following the spontaneous circulation after cardiopulmonary resuscitation, VA-ECMO was implemented successfully and the patient was discharged with full recovery.

5. CONCLUSION

HELLP and preeclampsia/eclampsia, and obstetric hemorrhages are the most common causes of ICU admissions among obstetric patients. Unfortunately, zero mortality is not yet reached. A multidisciplinary approach is important for the treatment and care of ICU patients. The follow-up and treatment of obstetric patients should be provided by a team of intensive care specialists, obstetricians and perinatologists together with intensive care nurses, physiotherapists, social workers, and families. Early diagnosis and timely treatment will prevent most complications. In this regard, we believe that developing the technological infrastructures in the ICU (such as ECMO, hemodiafiltration and PiCCO monitoring) and implementing a multidisciplinary approach will cause a significant reduction in maternal mortality and morbidity. However to conclude this, still a more comprehensive, multicentric, high volume assessment is needed to see the impact of new approach and recent technologies.

REFERENCES

