Obstetric Admissions in ICU in a Tertiary Care Center: A 5-Years Retrospective Study

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ABSTRACT

Background and Aim: Obstetric patients admitted to intensive care unit (ICU) represent a challenge to physicians. The purpose of this study is to evaluate the incidence, characteristics, and mortality of pregnant and postpartum patients requiring ICU admission.

Materials and Methods: A retrospective cohort study was performed between January 2008 and December 2013 at the University Hospital Federico II of Naples including pregnant and puerperal women until the 42nd day of postpartum and admitted to ICU.

Results: Patients admitted with an obstetric diagnosis had a higher incidence of at least one previous cesarean section, were treated more with hysterectomy, had an increasing incidence of hemodynamic instability, had more postpartum admission, had a higher TISS-28 score, and required more endotracheal intubation than patients admitted with non-obstetrics diagnosis.

Conclusion: A shared approach including a close collaboration between ICU and obstetric ward may be useful to reduce ICU admission and to improve maternal and foetal outcomes.

Keywords: Intensive care unit, Obstetric patient, Postpartum patient, Tertiary care facility

INTRODUCTION

Obstetric patients admitted to intensive care unit (ICU) represent a challenge to intensivists due to the physiological adaptations and progress of disease during pregnancy and puerperium. The challenge is even more difficult because of the necessity to safeguard health of the mother and survival of the foetus. There is a striking connection between the number of maternal deaths and the accessibility to ICU care since the countries with the highest number of maternal deaths are also those with the lowest number of beds per capita in ICU. The injury severity scores at ICU admission in developing countries are significantly higher compared to developed countries. This means that the delay of accessibility to ICU care is the leading factor for increasing maternal mortality. The prevalence of ICU admissions among obstetric patients varies from 1 to 9 for 1,000 pregnancies, representing less than 1% of all ICU admissions. In the United Kingdom and United States, the ICU admission rate is 0.9% of all pregnancies with mortality rates ranging from 5 to 20%. In a retrospective analysis of 1,023 critically ill obstetric patients, the authors identified age, race, socio-economic conditions, and prenatal care as risk factors for ICU admission. Reasons for ICU admissions included conditions related to pregnancy (preeclampsia-eclampsia, haemorrhage, cardiomyopathy, puerperal infections, etc.), conditions unrelated (congenital and valvular heart disease, pulmonary hypertension, renal failure, etc.) to pregnancy, and medical pathologies worsened by pregnancy. Obstetric patients admitted in ICU are younger and have less comorbidities than general female population. Obstetric ICU patients also have lower mortality rate compared with general ICU female population (2–3% vs 20%). The aim of the present study is to evaluate the incidence, characteristics, and mortality of pregnant and postpartum patients requiring ICU admission in a tertiary care facility.

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MATERIALS AND METHODS

This retrospective cohort study was performed at the University Hospital Federico II of Naples, Italy, a tertiary care facility with 2,300 births per year and a referral centre for high risk pregnancies. The institutional ethics committee approved the study protocol. This hospital is equipped with an obstetrical emergency room with dedicated staff and has 14 beds in general ICU.

In this study, we included all pregnant and puerperal women until the 42nd day after the birth, aged more than 18 years, and admitted to the ICU between 1st January 2008 and 31st December 2013. The obstetric patients were identified from the ICU admission records; the readmissions occurred within 30 days have been only counted once. Characteristics of the patients admitted in ICU were collected from the medical charts available in the archive of our department, recorded on a pre-filled form, and entered in a computerized database using MS Office Excel 2007 (Microsoft, Redmond, WA, USA).
Reasons of ICU admission were classified in two groups according to presence of disease related (obstetric group) or unrelated (non-obstetric group) to pregnancy.

For disease related to pregnancy, we included the following conditions:

Severe pre-eclampsia was identified by the presence of arterial hypertension (>160/110 mm Hg with proteinuria higher than 2 gm over 24 hours), with one or more of the following signs or symptoms like oliguria, epigastric pain, migraine, blurry sight, and pulmonary oedema.

Eclampsia was defined as the onset of seizures during pregnancy or in the early postpartum period not due to drugs or other maternal diseases.

HELLP (hemolysis, elevated liver enzymes, low platelets) syndrome was characterized by haemolysis (bilirubin > 1 mg/dL or haptoglobin < 0.5 mg/dL or schistocytes in the peripheral blood), low platelet counts (<100,000/mm³), and increase of hepatic cytolysis indexes (Alanina Amino Transferase > 70 U/L or Gamma-Glutamyl Transferase > 70 U/L).

Major obstetric hemorrhage was defined as blood loss between 1000 mL and 1500 mL in a short period or more than 2500 ml in 24 hours.

Massive obstetric hemorrhage was defined as a blood loss higher than 1500 mL, or the need for blood transfusions of more than 4 units of packed blood cells, or surgery for the control of hemostasis (embolization or hysterectomy), or hemoglobin level lower than 4 g/dL or presence of signs of shock.

Peripartum cardiomyopathy was identified as the development of left ventricular dysfunction (ejection fraction < 45%) in the last month of pregnancy or within the first 5 months during the postpartum period, in the absence of preexisting cardiac diseases and any identifiable causes of congestive heart failure.10

For non-obstetric admission, we included patients who need admission in ICU for reasons not related to pregnancy.

At the ICU admission for each patient, we measured the following:

- Sequential organ failure assessment (SOFA) score
- Simplified acute physiology score II version (SAPS II)
- ICU length of stay (ILOS)
- Hospital length of stay (HLOS)
- Therapeutic intervention scoring system (TISS 28)

Categorical data were expressed in percentages and compared with the chi-square test. Continuous data were reported as mean and standard deviation and compared with the Student’s t-test for unpaired samples. Statistical significance was set with a p value less than 0.05. The statistical analysis was carried out using the IBM SPSS software (version 20.0, IBM Corporation, New York, USA).

**RESULTS**

From 1st January 2008 to 31st December 2013, 66 obstetric patients were admitted to our ICU, representing 0.5% of hospital deliveries (66/13 422 deliveries) and 2.9% of all ICU admissions (66/2 287). The yearly percentage of obstetric patients compared to all patients admitted to ICU ranges from 1.6 to 4.2% (2008: 3.4%; 2009: 4.2; 2010: 1.6%; 2011: 3.5%; 2012: 3.2%; 2013: 1.6%). Only one woman died in 2010. Table 1 shows the maternal characteristics and comorbidities. At the ICU admission, 38 patients (57%) had a diagnosis related to obstetric disease while 28 (43%) had a non-obstetric related diagnosis. The incidence of previous cesarean section was statistically different between the considered groups.

**Table 1: Maternal characteristics and comorbidities**

| Comorbidities | Total n = 66 (n; %) | Obstetric admissions n = 38 (n; %) | Non obstetric admissions n = 28 (n; %) | p value |
|---------------|---------------------|-------------------------------|----------------------------------------|---------|
| Heart disease | 10; 15%             | 5; 13%                        | 5; 18%                                  | 0.858   |
| Arterial hypertension | 2; 3% | 2; 3% | 0 | 0.612 |
| Hemostatic disorder | 5; 8% | 1; 5% | 4; 14% | 0.148 |
| Morbid obesity (BMI >35) | 2; 3% | 2; 5% | 0 | 0.612 |
| Asthma | 2; 3% | 1; 2.5% | 1; 3.5% | 0.612 |
| Autoimmune disease | 2; 3% | 1; 2.5% | 1; 3.5% | 0.612 |
| Hypothyroidism | 4; 6% | 3; 8% | 1; 3.5% | 0.467 |
| Malignancy | 3; 4% | 2; 5% | 1; 3.5% | 0.744 |
| Chronic renal failure | 1; 1% | 0 | 1; 3.5% | 0.876 |
| Diabetes mellitus type I | 1; 1% | 1; 2.5% | 0 | 0.876 |
| Chronic infection (HIV, HBV) | 2; 3% | 1; 2.5% | 1; 3.5% | 0.61 |
| Cerebrovascular accident | 2; 3% | 2; 5% | 0 | 0.612 |
| Others**** | 6; 9% | 4; 10% | 2; 7% | 0.964 |

**Table 1:** Maternal characteristics and comorbidities.

**Notes:**

1. *p* values were calculated with the chi-square test for categorical data and with the Student’s t-test for continuous data.

2. **=4 twin and one triplet pregnancies; ****Systemic mastocytosis, chronic venous insufficiency, chronic inflammatory demyelinating polyneuropathy, kidney stone, cerebral angiomatosis, cushing syndrome
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Table 2: Mode of delivery and anesthesiological procedures

|                           | Total n = 63 | Obstetric diagnosis n = 38 | Non obstetric diagnosis n = 25 | p value |
|---------------------------|--------------|----------------------------|--------------------------------|---------|
| Vaginal delivery          | 3 (5%)       | 2 (5%)                     | 1 (4%)                         | 0.708   |
| Cesarean section*         | 60 (95%)     | 36 (95%)                   | 24 (96%)                       | 0.708   |
| – Elective                | 11           | 3                          | 8                              |         |
| – Planned                 | 13           | 12                         | 1                              |         |
| – Urgent                  | 29           | 16                         | 13                             |         |
| – Emergent                | 7            | 5                          | 2                              |         |
| Spinal/epidural anesthesia| 24 (40%)     | 14 (37%)                   | 10 (40%)                       | 1       |
| General anesthesia        | 36 (60%)     | 22 (63%)                   | 14 (60%)                       | 0.912   |
| ASA I-II                  | 22 (37%)     | 12 (32%)                   | 10 (40%)                       | 0.677   |
| ASA III-IV                | 36 (60%)     | 26 (68%)                   | 13 (52%)                       | 0.294   |
| ASA V                     | 2 (3%)       | 0                          | 2 (8%)                         | 0.299   |
| Hysterectomy              | 17 (27%)     | 17 (45%)                   | 0                              | 0.000   |
| Uterine artery embolization| 3 (5%)      | 3 (8%)                     | 0                              | 0.403   |

* According to Lucas classification of urgency of cesarean section

Table 3: Intensive care unit admission diagnosis

| Obstetric Diagnosis                  | Total 28/66 (42%) |
|--------------------------------------|-------------------|
| Hypertensive disease                 | 16/66(25%)        |
| HELLP syndrome*                      | 7/16              |
| Eclampsia                            | 4/16              |
| Eclampsia                            | 3/16              |
| AFLP**                               | 2/16              |
| Major hemorrhage                     | 9/20              |
| Uterine atony                        | 6/20              |
| Abnormal invasive placenta           | 9/20              |
| Retained placental tissue            | 1/20              |
| Abruptio placenta                    | 2/20              |
| DIC/Intrauterine fetal death***      | 2/20              |
| Puerperal sepsis                     | 1/1 (1%)          |
| Peripartum cardiomyopathy            | 1/1 (1%)          |
|                                    |                   |
| Non Obstetric Diagnosis              |                   |
| Hypertensive disease                 | 5/66 (7%)         |
| Pneumonia ****                       | 3/5               |
| Pyleonpehrisis                       | 1/5               |
| Other (H1N1)                         | 1/5               |
| Pulmonary embolism                   | 5/66 (7%)         |
| Heart diseases                       | 4/66 (6%)         |
| Acute renal failure                  | 2/66 (3%)         |
| Pulmonary atelectasis                | 2/66 (3%)         |
| Miscellaneous                        | 7/66 (11%)        |
| Major trauma                         | 1/7               |
| Seizures                             | 1/7               |
| Bowel obstruction                    | 1/7               |
| Chronic inflammatory demyelinating   | 1/7               |
| Polynupropathy                       | 1/7               |
| Oral cancer                          | 1/7               |
| Systemic mastocytosis                | 1/7               |
| Pulmonary edema                      |                   |

*HELPL: Hemolysis, elevated liver enzymes, low platelets; **AFLP: Acute fatty liver of pregnancy; ***DIC: Disseminated intravascular coagulation; ****Two cases of community acquired pneumonia (CAP, Streptococcus pneumonia) and one case of hospital acquired pneumonia (HAP, Pseudomonas aeruginosa)

(Obstetric patients: 22/38; non-obstetric: 6/28; p = 0.006). During the study period, more than 90% of patients in each group had a cesarean section. Hysterectomy was performed in 45% of obstetric patients with statistical significance (p = 0.000). Table 2 shows the mode of delivery and related anaesthesiology procedures.

Table 3 shows the reasons for ICU admission. The most frequent reason of ICU admission in obstetric group was major haemorrhages (31%) followed by hypertensive disorders (25%). The most frequent reason of ICU admission in non-obstetric group was pulmonary embolism (7%) and non-obstetric sepsis (7%).

Table 4 shows the incidence of organ failures at the ICU admission. Hemodynamic failure was the main reason of ICU admission in obstetric group (p = 0.011). Hemodynamic instability included severe arterial hypertension resistant to pharmacological treatment with two or more drugs (3/27), cardiac dysfunction (3/27), and severe sepsis/septic shock (2/27). Hemodynamic failure was more frequent in obstetric group (p = 0.011). Respiratory failure was more frequent in the non-obstetric group (43%) (p = 0.000). Two patients showed cardiorespiratory failure due to massive pulmonary thromboembolism. For post-operative monitoring, 18% of non-obstetric patients with preexisting pathologies were admitted in ICU (p = 0.012).

Table 5 shows characteristics and complications during the ICU stay. In non-obstetric group, 32% of patients were admitted before they gave birth while 100% of obstetric patients were admitted in the postpartum period. Nine patients out of 66 were admitted while still pregnant. Among these patients, four underwent emergency cesarean section (c-section), two patients gave birth after the ICU discharge, one patient had a spontaneous abortion, and two patients were lost to the follow-up. The most frequent complication during ICU stay was the need of surgery.
Table 4: Organ failures at the ICU admission

| Total | Obstetric admissions | Non obstetric admissions | p value |
|-------|----------------------|--------------------------|---------|
|       | n = 66 (n; %)        | n = 38 (n; %)            | n = 28 (n; %) |
|       |                      |                          |         |
| Hemodinamic failure | 27; 41%              | 23; 61%                  | 4; 14%  | 0.011 |
| Respiratory failure | 12; 18%              | 0                        | 12; 43% | 0.000 |
| Hemodinamic and respiratory failure | 2; 3% | 1; 3% | 1; 4% | 0.831 |
| DIC/TTP/HUS* | 9; 14% | 8; 21% | 1; 4% | 0.070 |
| Neurological dysfunction | 6; 9% | 4; 11% | 2; 7% | 0.665 |
| Hepatic failure | 2; 3% | 2; 5% | 0 | 0.229 |
| Acute kidney failure | 2; 3% | 0 | 2; 7% | 0.106 |
| Bowel obstruction | 1; 1% | 0 | 1; 4% | 0.248 |
| Postoperative monitoring | 5; 8% | 0 | 5; 18% | 0.012 |

*DIC: Disseminated intravascular coagulation; TTP: Thrombotic thrombocytopenic purpura; HUS: Hemolytic uremic syndrome

Table 5: Characteristics and complications of ICU stay

| Total | Obstetric admissions | Non obstetric admissions | p value |
|-------|----------------------|--------------------------|---------|
|       | n = 66               | n = 38                   | n = 28  |
|       |                      |                          |         |
| Antepartum admission (n; %) | 9; 14% | 0 | 9; 32% | 0.000 |
| Postpartum admission (n; %) | 57; 86% | 38; 100% | 17; 78% | 0.000 |
| HLOS (days) (mean; SD; range) | 18; 9; 1–50 | 20;9; 6–42 | 17; 10; 1–50 | 0.1793 |
| ILOS (days) (mean; SD; range) | 5; 4; 1–29 | 5; 4; 2–23 | 4; 5;1–29 | 0.559 |
| Endotracheal Intubation at admission (n; %) | 35; 53% | 25; 66% | 10; 36% | 0.031 |
| SAPS II (mean; SD; range) | 26; 13; 16–36 | 28; 12; 8–64 | 23; 15; 3–51 | 0.155 |
| TISS-24 (mean; SD; range) | 30; 11; 5–59 | 34; 11; 16–59 | 27; 12; 5–56 | 0.019 |
| SOFA score (mean; SD; range) | 4; 3; 0–12 | 5; 3; 1–12 | 4; 3; 0–11 | 0.051 |

Complications

| Related to ICU admission diagnosis | Total n = 66 (n; %) | Obstetric admissions n = 38 (n; %) | Non obstetric admissions n = 28 (n; %) | p value |
|-----------------------------------|---------------------|------------------------------------|----------------------------------------|---------|
| Need for re-surgery | 10; 15% | 5; 13% | 5; 18% | 0.858 |
| PRES | 5; 8% | 5; 13% | 0 | 0.127 |
| Acute renal failure | 4; 6% | 2; 5% | 2; 7% | 0.837 |
| Cerebral ictus (ischemic, hemorrhagic) | 3; 5% | 3; 8% | 0 | 0.332 |
| DIC | 2; 3% | 2; 13% | 0 | 0.612 |
| Postoperative paralytic ileus | 2; 3% | 2;13% | 0 | 0.612 |
| Miscellaneous* | 2; 3% | 1; 3% | 1; 2% | 0.612 |

Related to ICU stay

| CVC related infection | 2; 3% | 1; 3% | 1; 2% | 0.612 |
| VAP | 2; 3% | 1; 3% | 1; 2% | 0.612 |
| Pulmonary edema due to volume overload | 2; 3% | 2; 13% | 0 | 0.612 |

*DIC: Disseminated intravascular coagulation; TTP: Thrombotic thrombocytopenic purpura; HUS: Hemolytic uremic syndrome

SOFa and SAPS scores did not differ between the groups, while TISS score was higher in the obstetric patients (p = 0.019).

Table 6 shows the characteristics and outcome of patients according to previous c-section. In our study, a history of one or more previous c-sections was associated to a higher risk of major hemorrhages (p = 0.011), hysterectomy (p = 0.000), and need of packed red blood cells transfusions (p = 0.050).

Sixty-seven infants were born alive with a birth weight (mean, DS) of 2370 ± 900 gm (range 410–4200), at a gestational age (mean, DS) of 35 ± 4 weeks (range 25–40) and with an Apgar score at 5 minutes (mean, DS) of 8 ± 1 points (range 2–9). A newborn died a few minutes after birth; there were 3 intrauterine foetal deaths and one spontaneous abortion. Perinatal mortality rate was 6%.
Furthermore, 45% of patients in obstetric group were treated with hysterectomy compared with none of patients with non-obstetric group. As far as we know, no previous studies reported this relationship. Hysterectomy mainly occurred in postpartum period because of uterine atony.6,7 Hysterectomy, as a major surgical procedure, is associated with high complication rates.6,7 Patients treated with hysterectomy should be carefully monitored in postoperative period, probably this is the reason why we have a high incidence of hysterectomy in our obstetric group.

In this study, hemodynamic instability (41%), as a consequence of postpartum hemorrhage, was the most frequent reason of ICU admission followed by respiratory failure (31%) due to pneumonia and pulmonary atelectasis, severe coagulopathies (14%), and neurological dysfunctions (9%). Hemorrhagic shock was the most common indication for ICU admission.17 The indications for mechanical ventilation in obstetric patients have been not properly identified.18,19 The percentage of mechanical ventilated patients in this study was relatively high (68%) compared to the current literature.17,18,20 In this study, the most common indications leading to mechanical ventilation were the need of inotropes and vasopressors in the postoperative period, the severe respiratory failure, and neurological dysfunction with the impairment of the airway reflex. According to this, mechanical ventilation was mainly administered through the endotracheal tube, otherwise it was a non-invasive support. Current evidence-based ventilatory management has been developed from studies that excluded pregnant women. The uncertainty in management of obstetric patient relates not only to the ideal ventilator settings for these patients, but also to the optimal oxygen and CO2 targets, and whether to emulate the normal maternal respiratory alkalosis.20

Obstetric ICU admission is a rare event in developed countries, although there are several potentially fatal conditions which may occur in peripartum period. In our study, approximately five women every 1,000 deliveries were admitted in ICU. International ICU admission rates varied from 0.7 to 1.3%, while 0.2–0.4% in developed countries.15,16 Also, the percentage of obstetric patients compared to the total of ICU admissions was comparable with the international data that ranged from 0.5 to 10.2%.17

In this study, patients admitted with pregnancy related diseases had a higher incidence of at least one previous cesarean section compared with patients without obstetric related diseases. Furthermore, 45% of patients in obstetric group were treated with hysterectomy compared with none of patients with non-obstetric group. As far as we know, no previous studies reported this relationship. Hysterectomy mainly occurred in postpartum period because of uterine atony.6,7 Hysterectomy, as a major surgical procedure, is associated with high complication rates.6,7 Patients treated with hysterectomy should be carefully monitored in postoperative period, probably this is the reason why we have a high incidence of hysterectomy in our obstetric group.

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In this study, patients admitted with pregnancy related diseases had a higher incidence of at least one previous cesarean section compared with patients without obstetric related diseases. Furthermore, 45% of patients in obstetric group were treated

**Table 6: History of previous cesarean section (CS) and outcome**

|                         | Total n = 66 | No previous cesarean section n = 38 | One or more previous cesarean section n = 28 | p value |
|-------------------------|--------------|------------------------------------|---------------------------------------------|---------|
| Non-obstetric admissions (n; %) | 28; 42%      | 22; 48%                            | 6; 21%                                      | 0.067   |
| Obstetric admissions (n; %)     | 38; 57%      | 16; 42%                            | 22; 79%                                     | 0.067   |
| Major hemorrhage (n; %)          | 20; 30%      | 5; 13%                             | 15; 54%                                     | 0.011   |
| Abnormal invasive placenta (placenta accreta and/or percreta) (n; %) | 9; 14%        | 1; 20%                             | 8; 53%                                      | 0.436   |
| Hysterectomy                  | 17; 26%      | 1; 3%                              | 16; 57%                                     | 0.000   |
| HLOS (mean, SD; range)        | 28; 6; 1–55  | 19; 10; 1–50                       | 18; 10; 7–42                                | 0.988   |
| ILOS (mean; SD; range)        | 37; 4; 1–27  | 5; 4; 1–29                         | 4; 2–23                                     | 0.798   |
| SAPS II, (predicted mortality %) (mean; SD; range) | 52; 15; 2–67 | 26; 13; 3–56                      | 26; 14; 6–64                                | 0.909   |
| Patients receiving red blood cells transfusion; (n; %) | 32; 48%      | 14; 37%                            | 18; 61%                                     | 0.050   |
| Patients receiving mechanical ventilation; (n; %) | 45; 68%      | 24; 63%                            | 21; 78%                                     | 0.451   |
| Patients developing at least one complication during ICU stay (n; %) | 21; 32%      | 14; 37%                            | 7; 22%                                      | 0.451   |
This study showed a 95% prevalence of cesarean section among the patients admitted in ICU. In 2000, an Italian study reported a 90.2% incidence of cesarean sections in critical obstetric patients.23 According to Lucas classification, cesarean section can be classified as emergent (immediate threat to mother and/or foetus life), urgent (compromised maternal conditions and/or of the foetus, which is not immediately life-threatening), planned (needing early delivery but no maternal or foetal compromise) or elective.24 In this study, 22% of c-sections were planned (nine for abnormal invasive placenta, two for malignant metastatic cancer, two for valvular cardiomyopathy, and one for HIV), 61% were emergent or urgent, while only 17% could be classified as elective.

Hemorrhage was the most frequent reason of ICU admission in obstetric group.14 Multiple parity, HELLP syndrome, disseminated intravascular coagulation (DIC), and cesarean section were the risk factors for obstetric hemorrhage. In our study, 49% of the patients received packed red blood cells transfusions, 33% received fresh frozen plasma, 10% received platelets, and 3% received clotting factor concentrates. Sixteen patients (24%) underwent hysterectomy immediately after the cesarean section or within the 2 days after the birth and three patients underwent embolization of uterine arteries. The most frequent condition associated with hysterectomy was abnormal invasive placenta followed by uterine atony. In one case, hysterectomy was performed because of puerperal sepsis due to endometritis unresponsive to antibiotics administration.

According to a study of the Italian National Health System Institute25 in six Italian regions during the period 2004–2005, obstetric hemorrhage was most frequently caused by placental abruption, followed by placenta previa. In this study, the greater prevalence of abnormal placentation could be due to the elevated number of c-sections performed in Italy (60% vs the national average of 38%), being the cesarean section itself one of the principal risk factors for abnormal placental insertion. On the other hand, ultrasound and MRI scans currently allow diagnosis of the anomalies of placentation before the birth.

C-section is an independent risk factor for severe maternal morbidity and mortality. In a large study, Silver et al. showed that the risk of severe complications considerably increases with the number of previous cesarean sections,26 other authors did not confirm this conclusion.27 In this study, the presence of one or more previous c-sections increased the probabilities of severe obstetric hemorrhages, packed red blood cells transfusions, and emergency hysterectomy, but they did not influence the length of ICU stay, the onset of complications, and the need for mechanical ventilation. Multiple parity, presence of HELLP syndrome, presence of DIC, and the performance of a cesarean delivery appeared as the precipitating factors for severe hemorrhages in obstetric patients.28

The mean length of ICU stay was 5 days, without any significant difference between patients with obstetric or non-obstetric diagnosis; whereas, 54% of the patients stayed in ICU for three days or less. This result fitted with the other studies29 and reflected the transitory nature of the majority of obstetric pathologies fixed by the delivery and the placental expulsion.

The incidence of maternal deaths in developed countries is about 2–3/100 deliveries (range 0–12%), and in developing countries, it is 10–25%.30,31 We observed only one maternal death because of massive pulmonary embolism, corresponding to a mortality rate of 1.5%, despite a predicted mortality rate of 12%. Regarding the causes of maternal deaths in developed countries, Homer et al. reported the embolism of amniotic fluid in 28% of cases, both the pregnancy hypertensive disorders and venous thromboembolism in 17% of cases, and obstetric haemorrhage in 14% of patients.30 The Eight Report of National Enquiries into Maternal Death in UK showed that up to 50% of maternal deaths are due to medical preexisting diseases exacerbated by pregnancy.3

The ICU prognostic scoring systems, such as APACHE II, does not take into account the physiological changes that occur in peripartum period nor the pathophysiological peculiarity of pregnancy related diseases. The SAPS II score is more reliable than the APACHE II to predict mortality in obstetric patients30,32 and may help to identify high-risk patients. In our study, the SAPS II score and the SOFA score seemed to be useful to predict ICU length of stay, but not the mortality rate (duration of stays >72 hours: average SAPS II score of 34±12 and average SOFA score of 6±3; stays <72 hours: SAPS II score 19±11 and SOFA score 3±2; p <0.05). A modified early obstetric warning system (MEOWS) chart is used from 20 weeks of gestation, when the woman is admitted to maternity wards, to the postnatal period up to the 6th week following childbirth. MEOWS score considers different physiological parameters specifically relevant for obstetric patients to recognize a possible deterioration in women’s condition.33 MEOWS should be used in the obstetric ward as a warning or screening tool for women at risk of developing serious illness.

One of the main limitations of this study was the retrospective design. The low number of patients did not allow the identification of prognostic factors between survivors and non-survivors. Similarly, we were not able to identify risk factors for ICU admissions before the birth due to the lack of a control group.

**Conclusion**

Management of the peripartum patients is a challenging aspect of critical care that requires consideration of the physiological changes associated with pregnancy and the well-being of the fetus. A shared approach including a close collaboration between ICU and obstetric ward may be useful to reduce ICU admission and to improve maternal and fetal outcomes.

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