Critical Illness in Pregnancy*
An Analysis of 20 Patients Admitted to a Medical Intensive Care Unit

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There is a paucity of literature with regard to the need for intensive care treatment of critically ill obstetric patients. In this review, the findings from 20 obstetric patients admitted to a medical ICU (MICU) over a 40-month period were analyzed. Demographics, preexistent medical problems, diagnoses, days in the hospital and the MICU, need for mechanical ventilation, maternal and fetal mortality, and invasive procedures were reviewed. (For comparison, a limited analysis of nonobstetric admissions to the MICU over the same time period were included.) Fifty percent (10) of the patients had preexisting medical problems. Maternal mortality was 20 percent (4 patients), with a fetal mortality of 35 percent (7). In all of the maternal deaths, adult respiratory distress syndrome was present. Although mortality and the need for mechanical ventilation did not differ between the obstetric and nonobstetric patients, pulmonary artery and arterial catheters were placed at a higher rate in the obstetric patients. Critically ill obstetric patients, although younger than general MICU patients, appear to have as great a risk of dying of their critical illness and have a high infant mortality.

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The pregnant patient with medical complications represents a unique challenge to the intensive care specialist and often requires the management expertise of several subspecialists. Although some tertiary care centers have maternal-fetal ICUs,1,4 many do not and use a general medical ICU (MICU) to assist in the care of critically ill pregnant patients, as discussed in a recent review.5 We have similarly reviewed our experience with critically ill pregnant patients in an MICU to ascertain a better understanding of the unique problems that these patients present to the medical intensive care specialist.

MATERIALS AND METHODS

The MICU at the Medical University of South Carolina (MUSC) is under the direction of the Division of Pulmonary and Critical Care. It is a seven-bed unit staffed by internal medicine residents, pulmonary/critical care fellows, and a pulmonary/critical care staff physician. All nurses are registered, and many are critical care registered nurses (CCRN). In addition to this staff, all obstetric patients are closely followed during their course in the MICU by a maternal/fetal fellow and staff physician. Admission of pregnant patients to the MICU was either from the obstetric floor or transfers from outlying community hospitals.

The records of all obstetric patients admitted to the MICU at MUSC between January 1988 and April 1991 were reviewed. The following data were obtained: maternal age, race, presence of preexisting medical problems, gravity/parity, week of pregnancy at admission, diagnoses upon admission to the MICU, total days of hospitalization, total days in the MICU, need for mechanical ventilation, and the cause and number of maternal deaths. Critical care diagnoses were divided into four categories: (1) respiratory failure, which included patients who required mechanical ventilation for respiratory failure, as well as patients who were moved into the MICU for impending respiratory failure; (2) eclampsia; (3) cardiac arrest; and (4) miscellaneous. The critical care diagnosis was established as the major cause for the patient requiring critical care. The underlying cause for each of these diagnoses was also noted. The adult respiratory distress syndrome (ARDS) was defined as hypoxemic respiratory failure (PaO₂ < 60 mm Hg with a fractional concentration of oxygen in the inspired gas [FIO₂] ≥ 0.60) requiring mechanical ventilation, in which the chest roentgenogram showed bilateral alveolar infiltrates and the pulmonary artery capillary wedge pressure was less than 18 mm Hg.

The type of delivery, fetal outcome, and the number of fetal deaths were recorded. A maternal death was considered to have occurred if the patient died prior to delivery or within 6 weeks postpartum. A fetal death was considered to have occurred if death occurred perinatally or within 6 weeks of birth.

Procedures uncommon for obstetric patients were also recorded (endotracheal intubation, pulmonary artery catheterization, arterial line placement, lumbar puncture, bronchoscopy, tube thoracostomy, thoracentesis, etc.). Central venous catheterization, cesarean section, dilation and curettage, and other surgical procedures limited to the female reproductive organs were excluded.

For comparison, a limited analysis of all medical admissions to our MICU for the same time period was also done. This included number of admissions, age, length of stay in the MICU, mortality, need for mechanical ventilation, and the number of arterial and pulmonary artery catheters placed.

Data are reported as the mean ± SEM. Chi-square analysis was used for comparisons between pregnant and nonpregnant patients admitted to the MICU.

RESULTS

Obstetric Patients

Demographics: Twenty obstetric patients were admitted to the MICU at MUSC from January 1988 to April 1991. The mean age was 24 ± 1 years (range, 16

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to 34 years). Fifty percent (10) of the patients were white, and 50 percent (10) were black. Forty percent (8) of the patients were primigravida; 45 percent (9) had had 2 or 3 prior pregnancies; and 15 percent (3) had had more than 3 prior pregnancies. Of the patients who presented antepartum (n = 17; 85 percent), the average week of pregnancy at presentation was 29 ± 2 (range, 12 to 41).

Diagnoses: Ten of 20 patients (50 percent) did not have medical problems prior to the onset of this pregnancy. The other ten patients had preexisting medical problems, defined as medical illnesses that were diagnosed prior to the patient’s pregnancy that required a physician’s evaluation. These are shown in the following tabulation listing numbers of patients:

- Hemoglobinopathy: 3
- Nephrotic syndrome: 1
- Hodgkins disease: 1
- Systemic lupus erythematosus: 1
- Mitral stenosis s/p mitral valve replacement (MVR): 1
- Dwarfism/situs inversus: 1
- Asthma: 1

Included are hematologic (4), renal (2), endocrine (1), pulmonary (1), connective tissue (1), and cardiac (1) illnesses. Of these patients, 8 had complications of their preexistent illness that contributed to their critical illness: sickle cell disease (2) nephrotic syndrome (2); Hodgkin’s disease (1); systemic lupus erythematosus (1); mitral stenosis (1); and asthma (1).

Critical care diagnoses are shown in the following tabulation giving numbers of patients:

- Respiratory failure: 12
- Pneumonia: 4
- Amniotic fluid embolism (presumed): 2
- Pulmonary edema (volume overload): 2
- ARDS (no obvious cause): 2
- ARDS from sepsis: 1
- Septic embol: 1
- Eclampsia: 4
- Cardiac arrest: 2
- Acute myocardial infarction: 1
- Unknown cause: 1
- Miscellaneous: 2
- Urosepsis: 1
- Drug overdose: 1
- Total: 20

Sixty percent (12) of the patients were admitted to the MICU because of respiratory failure. The most common cause of their respiratory failure was pneumonia, which was present in 4 of the 12 (33 percent). Pulmonary edema, either due to volume overload or ARDS, accounted for respiratory failure in five patients. Two patients had presumed amniotic fluid emboli. Eclampsia was the cause for admission to the MICU in 20 percent (4) of the patients. These patients had seizures or malignant hypertension (or both) requiring critical care.

Maternal Outcome: Hospitalization averaged 18 ± 4 days (range, 2 to 73 days). The average number of days in the MICU was 8 ± 3 (range, 1 to 41 days). In 5 of the 20 patients (25 percent), the stay in the MICU was 24 h or less. Twelve of the 20 patients (60 percent) required mechanical ventilation. Of those patients, five were intubated before or during delivery, six were intubated after delivery, and one did not deliver during the hospitalization. Delivery while on mechanical ventilation dramatically improved the condition of only one of five patients. This patient had premature labor secondary to pneumonia. Respiratory failure ensued, and because of hypoxemia, labor was induced at 33 weeks’ gestation. The patient had dramatic improvement in oxygenation after delivery, allowing extubation 48 h later. Of the other four patients who required mechanical ventilation during delivery, one suffered a cardiac arrest and subsequently had spontaneous abortion of a fetus at 17.5 weeks’ gestation. The other three patients went into labor spontaneously. One had eclampsia and was admitted in status epilepticus; she required continued mechanical ventilation due to aspiration pneumonia. The other two had ARDS and required prolonged mechanical ventilation.

The mean duration of mechanical ventilation was 10 ± 3 days (range, 1 to 39 days). Six of the patients receiving mechanical ventilation required positive end-expiratory pressure greater than 5 cm H₂O. There were four maternal deaths (20 percent), all in the group requiring mechanical ventilation. Three of the four deaths occurred in patients with preexisting medical illnesses. The causes of death in these 4 patients were multiorgan system failure (2), cardiac arrest/asystole (1), and brain death (1) (Table 1). All maternal deaths occurred in patients who concurrently had ARDS. Fetal mortality was 100 percent (4) in the patients who died. Two of the fetuses were nonviable (<24 weeks’ gestation) at the time of admission to the MICU; one patient had Hodgkin’s disease and underwent a therapeutic abortion at 12 weeks’ gestation; the other was the patient who had a spontaneous abortion of a 17.5-week fetus following cardiac arrest. Of the

Table 1—Maternal Mortality in Obstetric Patients Admitted to MICU

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Days of Hospitalization</th>
<th>Cause of Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hodgkins disease; ARDS</td>
<td>5</td>
<td>Abortion</td>
</tr>
<tr>
<td>Systemic lupus erythematosus; preeclampsia; ARDS; seizesures</td>
<td>73</td>
<td>Vaginal</td>
</tr>
<tr>
<td>Sepsis with multiorgan failure and ARDS; bronchiolitis obliterans with organizing pneumonia; DIC</td>
<td>27</td>
<td>Abortion</td>
</tr>
<tr>
<td>Acute myocardial infarction; aspiration pneumonia with multiorgan failure and ARDS; S/P MVR (1976)</td>
<td>20</td>
<td>Abortion</td>
</tr>
</tbody>
</table>

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two viable fetuses, one fetus was spontaneously aborted after premature labor at 25 weeks' gestation, and the other fetus was delivered at 26.5 weeks' gestation after induction of labor due to maternal distress. He required immediate intubation and transfer to the neonatal ICU, where he died 42 days later.

**Fetal Outcome.** Of the 20 patients the outcome of only one pregnancy was undetermined (did not deliver during admission and was lost to follow-up). Of the 16 patients who delivered during the recorded admission, 9 (56 percent) had a vaginal delivery, 4 (25 percent) underwent cesarean section (1 of which was performed on a fetus that died in utero), and 3 (19 percent) had abortions (stillborns); 1 of the 3 abortions was therapeutic. Six of the nine vaginal deliveries occurred in the MICU. There was a 35 percent (7/20) overall fetal mortality. Gestational ages of the fetuses who died ranged from 12 to 41.4 weeks; 2 of the fetuses were nonviable at 12 and 17.5 weeks. One fetus suffered intrauterine fetal death at 41.4 weeks' gestation.

**Procedures:** On average, 4.3 ± 1.3 invasive procedures were performed on each patient. Fifty-five percent (11) of the patients required endotracheal intubation, 1 of whom was intubated on 4 separate occasions. A total of 25 arterial catheters were placed in 10 patients (range, 1 to 6 per patient), with an average number of arterial catheters in all obstetric patients of 1.3 ± 0.4. Half of the patients (10/20) had pulmonary artery catheterization; 2 required more than 1 catheter. The average number of pulmonary artery catheters in all obstetric patients was 0.8 ± 0.2. Other invasive procedures performed included lumbar puncture (3), fiberoptic bronchoscopy (4), thoracentesis (10; 2 required >1), and tube thoracostomy (9; 3 required >1). Other procedures performed on individual patients included pericardiocentesis, bone marrow biopsy, and anoscopy. Two patients required tracheostomy for prolonged ventilation, and one had an open lung biopsy. In addition to these invasive procedures, one patient required hemodialysis for acute renal failure.

**Nonobstetric Patients**

From January 1988 through April 1991, there were 845 patients admitted to the MICU at MUSC (inclusive of the obstetric patients). This number includes only patients under the care of the MICU “team” and not “boarders” from other services. Obstetric admissions were 2 percent of this population. Since only monthly totals were available for these patients, only means are shown. The mean age of these patients was 53 years, and the average length of stay in the MICU was 5 days. Excluding the obstetric patients, overall mortality was 16 percent (135 patients). Of the 825 patients, 49 percent (401) required mechanical ventilation. There were 107 pulmonary artery catheters

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Mean Data for Nonobstetric and Obstetric Patients Admitted to MICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Nonobstetric Patients</td>
</tr>
<tr>
<td></td>
<td>(n = 825)</td>
</tr>
<tr>
<td>Age, yr</td>
<td>53</td>
</tr>
<tr>
<td>Length of MICU stay, d</td>
<td>5</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>16</td>
</tr>
<tr>
<td>No. with mechanical ventilation (%)</td>
<td>401 (49)</td>
</tr>
<tr>
<td>No. per patient</td>
<td></td>
</tr>
<tr>
<td>Pulmonary artery catheters</td>
<td>0.1</td>
</tr>
<tr>
<td>Arterial catheters</td>
<td>0.2</td>
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*p<0.01.

(mean of 0.1 per patient) and 202 arterial lines (mean of 0.2 per patient) placed.

A comparison of the obstetric patients and the nonobstetric patients is shown in Table 2. Statistical significance could not be calculated for age or length of stay. There was no significant difference between the general MICU patients and the obstetric patients with regard to the need for mechanical ventilation or mortality. The obstetric patients did have significantly more pulmonary artery catheters and arterial catheters than the MICU patients (p<0.01).

**DISCUSSION**

Pregnancy represents a unique alteration in physiology that usually proceeds to its completion without complication; however, in certain instances, complications, sometimes life-threatening, occur that require intensive care with invasive monitoring and mechanical ventilation. Using 1990 as our index year, 0.29 percent of all obstetric admissions to the MUSC Hospital required a stay in the MICU.

What is unique about this population? They are younger than the usual MICU population. Despite their youth, they were found to have a similar mortality. This may be attributed either to the alteration in physiology due to the pregnant state or to an underlying medical illness. With regard to the latter, 50 percent of the pregnant patients in this review were found to have preexisting medical problems. Eighty percent of those patients had a worsening of that condition which contributed to their death. Examples include two patients with nephrotic syndrome who went on to develop pulmonary edema, a patient with valvular heart disease who suffered sudden death, and a patient with an exacerbation of asthma associated with pneumonia. These examples suggest that those patients with prior disease are at risk for complications and deserve close prenatal monitoring.

Of the critical care diagnoses, eclampsia and amniotic fluid embolism are unique to the pregnant population. In addition to the four patients with eclampsia, two other patients admitted to the MICU had pre-eclampsia. In two series examining maternal-fetal ICU
admissions, hypertensive diseases accounted for 46 percent and 57 percent of ICU admissions, compared to 30 percent in our series.1,3 The overall frequency of pregnancy-related hypertensive disease is 5 to 7 percent, with the maternal mortality reportedly as high as 13 percent.6,7 Not all patients with preeclampsia require intensive care; however, patients who develop pulmonary edema, oliguria, or malignant hypertension may require invasive hemodynamic monitoring best handled in an ICU setting.6,9

Amniotic fluid embolism carries a more ominous prognosis, with an overall mortality approaching 85 percent. It is estimated to account for 11 to 13 percent of all maternal deaths.10 This diagnosis is suggested clinically with acute onset of dyspnea, tachypnea, and cyanosis associated with labor or the early puerperium.7,11 The two patients presumptively diagnosed in our series survived despite the development of disseminated intravascular coagulation (DIC).

The need for mechanical ventilation is a frequent reason for admission to an MICU. Sixty percent of the obstetric patients required mechanical ventilation at some point during their MICU stay. This was similar to the general MICU population. Another review of obstetric patients requiring critical care noted 59 percent (19) of 32 patients who required mechanical ventilation.8 Although respiratory physiology in the pregnant patient is altered (chronic compensated respiratory alkalosis and decreased functional residual capacity4), mechanical ventilation of the pregnant patient does not appear to be different from the general MICU patient. The most common reason for the requirement of mechanical ventilation in our population was pulmonary edema/ARDS. All of the pregnant patients who died had ARDS at the time of death. The high mortality associated with ARDS has been noted in other obstetric MICU series,4,13 and the 50 percent mortality in our population parallels the 50 to 70 percent mortality in all ARDS populations.14

The other series similar to ours reported a mortality of 33 percent in patients with ARDS requiring mechanical ventilation;3 however, their definition of ARDS did not include pulmonary wedge pressure measurements, and this may account for a lower mortality if some of their patients had cardiogenic rather than permeability pulmonary edema. In addition, all of their patients with presumed ARDS had an associated infectious cause. Possibly some of their patients had pneumonia, rather than ARDS, and again would have had a greater likelihood of improvement with appropriate therapy.

Fetal mortality is high in this group of patients. One other series, which related experience in an obstetric and neonatal ICU, had neonatal mortality associated with mothers treated in the ICU ranging from 16 to 40 percent.5 The 35 percent mortality observed in the present series is similar. Of the seven fetal deaths, one patient required a therapeutic abortion. She was at 12 weeks' gestation at presentation and had stage IV Hodgkin's disease. One patient presented at 41.4 weeks with intrauterine fetal death. Two patients had spontaneous abortions, 1 at 17.5 weeks' gestation and the other at 24 weeks' gestation. These four deaths were likely not preventable. Of the other 3 deaths, the gestational ages were 26.5, 26.5, and 28.4 weeks. One of these three infants was born in the MICU; one was born by cesarean section. Two of the three infants were born after induction of labor due to maternal distress; the third was born after premature rupture of membranes in the setting of chorioamnionitis. All infants were less than 1,500 g at birth and had respiratory distress syndrome after birth. These 3 infants were hospitalized in the neonatal ICU and survived for 4, 18, and 42 days. One infant had Ebstein's anomaly at birth. The infant born to the mother with chorioamnionitis developed suppurative pneumonia. Although neonatal mortality has decreased in recent years, still one half of all neonatal deaths occur in infants weighing less than 1,500 g at birth.15 These infants were at high risk due to their prematurity and died despite aggressive resuscitation and intensive care.

Frequently, patients in the MICU require invasive procedures. The types of procedures performed on the obstetric patients were not different from those performed in any MICU. Proposed indications for pulmonary artery catheterization in obstetric patients are cardiac disease or dysfunction, pulmonary disease or dysfunction, renal dysfunction, and sequelae of systemic infection.16 Our obstetric patients frequently required arterial and pulmonary artery catheters, and the use was significantly more frequent than the general MICU population. This may be because of the high incidence of pulmonary edema and hypertensive disorders in the obstetric population.

In conclusion, critically ill obstetric patients represent a unique population to the MICU. They often present with preexisting medical disease, as well as illnesses specific to the pregnant state. Although they are younger, their mortality and need for mechanical ventilation are similar to the general MICU patients, indicating that they are indeed critically ill and require intensive care. Furthermore, their infant mortality is extremely high. Intensive care specialists who care for critically ill obstetric patients should be familiar with the more common complications of pregnancy and should work closely with obstetricians in their comprehensive care, in order to improve maternal and fetal outcome.

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