

Obstetric admissions to the intensive care unit

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ABSTRACT

Objective: To describe clinical characteristics, interventions required, and outcome of critically ill obstetric patients admitted to a general intensive care unit (ICU).

Methods: All obstetric patients admitted to ICU at Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia from 1997 to 2002 were included in the study. The data related to demographics, obstetric history, pre-existing medical problems, indications for ICU admission, intervention required, length of stay, and outcome of ICU admission were collected by retrospective review of medical records.

Results: The 99 obstetric admissions to ICU were represented by 0.2% of all deliveries and 1.6% of all ICU admissions. Most patients were young (median age of 30 years) with parity (median) of 3 and stayed in ICU for an average of 2 days. All except one patient were admitted during the postpartum period. The majority (76%) were admitted after cesarean section. Obstetric hemorrhage (32%) and hypertension (29%) were the 2 most common indications for admission. The majority (59/99) of patients also had pre-existing medical problem and most

common (16/59) was rheumatic heart disease. Preeclampsia (23/99) and eclampsia 10/99 were the most frequent obstetric complication. Thirty-six percent of our patients required ventilatory support. In the majority of patients, direct arterial (81%) and central venous (73%) pressure monitoring was carried out. Pulmonary arterial and left atrial pressure was monitored in 4%. Almost one third of patients received antihypertensive therapy. Inotropic support was given to 9% and blood (and its products) was given to 46% of patients. Antibiotics (28%) and magnesium sulphate (25%) were the most frequently used medicines. Out of the total 99 admissions, one patient died and 16 patients developed complications.

Conclusion: In our survey, the 2 most common indications for admitting obstetric patients to ICU were hemorrhage and hypertension. Invasive hemodynamic monitoring and ventilatory support are the 2 main interventions. Improving quality of care before and after admission to ICU may reduce maternal morbidity.

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A number of obstetric complications and pregnancy induced diseases can be life threatening and necessitate patient transfer to the intensive care unit (ICU). In countries where obstetric mortality is rare, the major morbidity serves as more valuable indicator of quality assurance. One indicator of pronounced maternal morbidity is transfer of patient to ICU.¹ Most of the studies on obstetric ICU patients are either small descriptive reports,²⁻⁴ narrow in their analysis⁵⁻⁷ or from dedicated obstetric ICU.⁸ The purpose of this study is to review all obstetric admissions to general

ICU over 6-years period, to analyze the frequency and cause of admission, clinical characteristics, (including ante or post natal, mode of delivery, pre-existing obstetric and medical problems), interventions, treatment given and maternal outcome.

Methods. Medical records of all obstetric patients admitted to ICU of Armed Forces Hospital, Riyadh, Kingdom of Saudi Arabia from 1997 to 2002 were reviewed. The data from medical

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records were collected under 5 main headings: related to patient's characteristics, indication for ICU admission, pre-existing obstetric and medical complications, ICU management and maternal outcome. Patient's characteristics included age, body weight and parity of the patient, gestational age at the time of admission and delivery, mode of delivery namely whether vaginal or operative elective/emergency delivery.

Indication for ICU admission was defined as the primary clinical problem for which patients were admitted to ICU. This was first categorized as obstetric and non-obstetric and then data were collected as hemorrhage, hypertension, cardiac dysfunction, respiratory failure or patient requiring intermittent positive-pressure ventilation (IPPV), neurologic dysfunction and miscellaneous (which includes liver failure, sepsis). Data for pre-existing obstetric complication and medical disorders, which were associated or responsible for critical condition of the patient, was also recorded. Medical disorders were categorized as cardiac, neurologic, endocrine, hematologic, renal, hepatic and muscular. Data on obstetric complications were recorded as preeclampsia, eclampsia, hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome, obstetric hemorrhage and postpartum sepsis. Intensive care unit related data were recorded as number of days in the ICU, invasive monitoring to measure blood pressure, right and left atrial pressure, ventilatory or inotropic support, blood and blood product transfusion and drug therapy (sedatives, analgesics and muscle relaxants were not recorded). Complications developed after admission to ICU were recorded as cardiac, renal, pulmonary, neurological and sepsis. Outcome of the mother whether she left alive or died in the ICU were also recorded.

There are more than 7000 deliveries per year in our obstetric unit. Thirty-three percent of women are with parity of more than 3 and the 17% are ≥ 35 -years of age. The incidence of cesarean section (CS) is 14%. One consultant and one resident provide obstetric anesthetic/analgesic service for elective procedures during day time and a second resident provides emergency obstetric anesthesia/analgesia service for 24 hours. Within the hospital premises, the ICU and obstetric unit are located in separate buildings, which are 200 meters apart. There is 16 bedded medical-surgical ICU, run by consultant and resident anesthetists. The ICU offers modern monitoring and supportive therapy and admits approximately 1000 patients per year. A senior registrar on site, provides support to residents on call.

Results. During the period of 6-years, a total of 99 obstetric patients were admitted to the ICU. This represents 0.2% of all deliveries and 1.6% of all ICU admission during this time. The number of admissions in each year is shown in **Table 1**. Demographic data of patient's age, body weight, parity, gestational age and duration of ICU stay are shown in **Table 2**. Except for one patient, all patients were admitted during postpartum period. Eighteen percent of patients delivered vaginally, 78% underwent obstetric and 3% underwent non-obstetric surgery prior to ICU admission. Alive babies were born to 91% of patients (**Table 3**).

Indications for ICU admission were obstetric (75%) and non-obstetric (25%). Eighty-one percent of patients were admitted with one indication and 18% with 2 indications (**Table 4**). The most common indication for ICU admission was massive hemorrhage (32%). The other indications were hypertension (29%), cardiac dysfunction (22%), respiratory failure (15%), neurological dysfunction (14%) and liver failure and sepsis (5%).

Pre-existing medical problems were present in 59/99 patients admitted to ICU (**Table 5**). Rheumatic heart disease was the most common medical problem (16/59). Some patients (6/59) had 2 or more medical problems.

Preeclampsia (23/99) and eclampsia (10/99 patients) were the most frequent obstetric complication. All hypertensive patients in this study except for 2 had preeclampsia/eclampsia. Five preeclamptic patients were diagnosed as HELLP syndrome; 2 of them also had massive hemorrhage. Sixteen patients had convulsions prior to ICU admission, 10 were eclamptic and 6 were non-eclamptic convulsions. Massive hemorrhage was the second most common obstetric complication. In all patients with massive hemorrhage, except for 2 were obstetrical. Six patients developed a coagulopathy. Post-partum sepsis due to obstetric causes occurred in 2 patients.

Intervention in ICU: Thirty-six percent of patients required ventilatory support, majority of them (29/36) required IPPV for period of >12 hours. In majority of patients, direct arterial (81%) and central venous (73%) pressure monitoring was carried out. In a few (4%) pulmonary arterial and left atrial pressures were monitored with Swan Ganz catheter. Inotropic support was given to 9% of patients. Almost one third (29/99) of patients received antihypertensive therapy and 13/29 patients received 2 or more antihypertensive drugs. Blood and blood products were given to 46% of patients. Half the number of patients received important drugs (other than inotropes and drugs used to facilitate IPPV) therapy. Antibiotic (28%) and magnesium sulphate (25%) were most frequently used. Sixteen out of 99 of patients developed

Table 1 - Obstetric admissions to intensive care unit (ICU) with percentage of all deliveries and all ICU admission.

Years	Obstetric admissions to ICU N	Total deliveries admitted to ICU n (%)	Total ICU admissions n (%)
1997	15	7590 (0.2)	929 (1.6)
1998	16	6887 (0.2)	995 (1.6)
1999	12	7860 (0.2)	1008 (1.2)
2000	12	7404 (0.2)	1044 (1.1)
2001	23	8414 (0.3)	1081 (2.1)
2002	21	8273 (0.3)	1030 (2.0)
Total	99	46428 (0.2)	6087 (1.6)

Table 4 - Number of patients and its indication in obstetric admissions to the intensive care unit (N=99).

Indications	n of patients
One indication (N=81)	
Hemorrhage	23
Hypertension	20
Cardiac dysfunction	18
Respiratory failure	5
Neurologic	11
Miscellaneous	4
Two indications (N=18)	
Hemorrhage and respiratory failure	3
Hemorrhage and liver failure	1
Respiratory failure and hypertension	4
Hypertension and neurologic dysfunction	1
Neurologic dysfunction and respiratory failure	1
Respiratory failure and cardiac dysfunction	2
Neuro and cardiac dysfunction	1
Hemorrhage and cardiac dysfunction	1
Hemorrhage and hypertension	4

Table 2 - Demographic data and intensive care unit (ICU) stay.

Demographic data	Median	Inter quartel range	Minimum	Maxamim
Age (years)	31	25 - 37	17	46
Body weight (kg)	70	64 - 78	33	115
Parity	3	0 - 5	0	10
Gestational age (weeks)	37	34 - 38	8	41
ICU stay (days)	2	1 - 2	1	60

Table 5 - Pre-existing medical diseases in obstetric patients admitted to intensive care unit (N=59).

Pre-existing medical diseases	n of patients
Cardiovascular (n=22)	
Rheumatic heart disease	16
Essential hypertension	1
Aortic aneurysm	1
Prinzmetal's angina	1
Coarctation of the aorta	1
Peripartum cardiomyopathy	1
Atrial septal defect	1
Neurological (n=9)	
Epilepsy	3
Sagittal sinus thrombosis	1
Pseudo-tumor cerebri	1
Dural puncture	1
Multiple sclerosis	1
Embolic stroke	1
Encephalitis	1
Respiratory (n=5)	
Asthma	4
Pneumonia	1
Endocrine (n=11)	
Diabetes mellitus	7
Hypothyroid	4
Renal (n=3)	
Acute renal failure	2
Chronic renal failure	1
Hepatic (n=4)	
Cirrhosis	1
Fatty liver and impaired liver function	3
Heamatological (n=4)	
Sickle cell trait	4
Muscular (n=1)	
Myositis	1

Table 3 - Obstetric and non-obstetric procedures patients underwent prior to intensive care unit admission and outcome of fetuses.

Procedure	Patients N	Number and outcome of babies
Vaginal delivery (VD)	18	17 alive, 1 IUFD
Total cesarean sections (CS)	76	73 alive, 4 IUFD
Elective CS	23	24 all alive
Emergency CS	38	35 alive, 3 IUFD
Cesarean-hysterectomy	15	14 alive, 1 IUFD
VD + removal of retained placenta	1	1 alive
Evacuation of retained product of conception	1	1 aborted
Non-obstetric surgery		
Removal of ruptured ectopic	1	1 aborted
Appendicectomy (postpartum)	1	1 alive
Intestinal resection	1	1 left in utero
IUFD - intra uterine fetal death		

complications in ICU, they were diagnosed as cardiac failure (4), respiratory failure (4), renal failure (4), septic shock (3) and neurological complications (seizure one, brain dead one). Out of 99 admissions, one patient died in ICU, the cause of death was encephalitis.

DISCUSSION. In critically ill obstetric patient, admission to ICU may become necessary for managing complications. The incidence of obstetric ICU admission in our study was 0.2% of the total deliveries, similar to the reported incidences from other countries which range between 0.1-0.4%.^{4,9} All our patients, except one, were admitted to ICU during the postpartum period and most patients (76/99) were admitted to ICU after CS. This is because most patients with obstetric and medical problems are delivered by CS, which compared to labor, promptly delivers the baby and placenta in a shorter time with less stress to the mother. From total deliveries during the period 1997-2002, 33% of the women were with parity of more than 3 and 17% were aged 35 years or more. For the obstetric patients admitted during the same period to ICU, 41% were with parity more than 3, and 35% were aged 35 years or more. Both age and parity are universally considered as risk factors for maternal mortality. The risk for obstetrics admission to ICU increases with increasing parity and not with increasing age.¹⁰ Increasing parity is associated with many obstetric complications which increases the risk to the mother to transfer to the ICU

Indications and causes of ICU admissions. As in the previous studies published from United State of America,⁸ Canada,¹ France,¹⁰ and China,⁹ the 2 most common indications for ICU admission in our survey were hemorrhage and hypertension. Together, both account for more than half of the obstetric admission to ICU. Both are also common direct causes of maternal deaths. Hemorrhage is responsible for 25% and hypertension 12% of direct maternal deaths in Saudi Arabia.¹¹ The accurate measurement of blood loss after the delivery of baby is difficult to measure. Therefore severity of postpartum hemorrhage may be best assessed by the fall in hematocrit or by the need for blood transfusion.¹² Obstetric causes of hemorrhage in this survey were placenta previa (10), atonic uterus (10), abruptio placenta (7), laceration of cervix (1), abortion (1) and rupture of ectopic pregnancy (1). Coagulation problems due to hemorrhage developed in 6/32 patients. A study among Riyadh's obstetric population of 30,000 total deliveries revealed 10 cases of severe obstetric hemorrhage were associated with disseminated intravascular coagulation.¹³ All hypertensive patients, (29/99) except 2, were due to preeclampsia/eclampsia disease. Severe peripheral vasoconstriction in pregnancy induced hypertension can cause left

ventricular failure and pulmonary edema. Aspiration of gastric content can occur during convulsion and when patient's level of consciousness is decreased. Neurological dysfunction in severe preeclampsia/eclampsia can occur due to complication or drug treatment (benzodiazepine) of the disease. In our hospital, cardiac dysfunction accounted for 1.2% of total deliveries, was the third most common (22/99) indication for ICU admission. Most common cardiac dysfunction was due to valvular stenosis or regurgitation because of rheumatic heart disease (RHD). This was diagnosed in 16/22 cases and all of them, except for 4, were electively admitted to ICU for monitoring, after elective CS. Six patients with cardiac dysfunction had non-rheumatic cardiac problems. Respiratory failure (15/99) was the fourth indication for ICU admission. The majority (9/15) of them were admitted with additional indications. Only 6 patients were admitted with primary pulmonary dysfunction. Three of them developed respiratory failure due to aspiration (2 had eclamptic convulsion and one aspirated during induction of general anesthesia for caesarean section), one admitted with bronchopneumonia and 2 developed muscle fatigue due to complication of myositis and diabetic ketoacidosis. Pulmonary embolism is a common cause of maternal mortality but a rare cause of obstetric admission to ICU.^{4,9} Also in our survey, there was no obstetric admission to ICU with confirmed diagnosis of pulmonary embolism. Neurologic dysfunction occurred in 14/99 patients. Ten of them had decreased levels of consciousness after convulsion due to disease (eclampsia 8/10 and epilepsy 2/10) or treatment (benzodiazepine). Epilepsy was the second most common cause of neurological dysfunction in this study. In 1994-1996, report on Confidential Inquiries into Maternal Deaths in the United Kingdom (UK), epilepsy was the second most common medical disorder associated with maternal mortality.¹⁴ Serious past medical history increased the risk of ICU admission.¹⁰ Pre-existing medical problems were present in 60% of patients admitted to our ICU. Two most common medical conditions were rheumatic heart disease (16/59) and diabetes mellitus (7/59). In our survey, rheumatic heart disease was also the most common non-obstetric cause of ICU admission. In UK the numbers of indirect deaths from medical conditions exacerbated by pregnancy are greater than deaths from conditions that directly arise from pregnancy. There heart disease was the most common non-obstetric cause of maternal death.¹⁵

Supportive therapy and invasive monitoring. Mechanical respiratory support was given to patients admitted with respiratory failure and to those (i) who at the time of admission were not in respiratory failure but hemodynamically or

metabolically unstable and (ii) who developed cardio-respiratory complications after ICU admission. Lapinsky et al¹⁶ reported 42% obstetric admissions to ICU required mechanical ventilation. Vasodilators are preferred in pregnancy induced hypertension. All patients (29/99) admitted with high blood pressure received hydralazine infusion. Hydralazine is the most widely used agent, and its major advantage is the extensive clinical experience with its use.¹⁷ Patient resistant to hydralazine may require addition of other antihypertensive drugs such as labetalol which may also suppress ventricular arrhythmias seen in some eclamptic patients.¹⁸ Nine patients received inotropic (dopamine) support. Three of them (with septic shock) also received noradrenaline infusion. Approximately half the number of patients admitted to ICU received transfusion of blood or blood product to achieve the hematological objective of hemoglobin >10.g /dl, platelets count >100,000/ml and normal clotting limits. One third of patients admitted to ICU received antibiotics in ICU. Cefuroxime and metronidazole were the most commonly used antibiotics. Magnesium sulphate is an anticonvulsant used to prevent and treat seizures associated with preeclampsia and eclampsia,¹⁹ was the second most common used drug used in our study. In general, the indications for invasive monitoring are similar to those in non-obstetric patients. American College of Obstetricians and Gynecologists has published guidelines for invasive hemodynamic monitoring in obstetric patients.²⁰ Majority of patients (81/99) in our study were monitored invasively which helped in understanding the cardiovascular patho-physiology and rationalized the use of fluid and inotrope/vasoactive drugs. One fifth of number of patients admitted to ICU for only monitoring purpose and did not required cardio-respiratory supportive therapy. Rheumatic heart disease was the most common (12/22) indication for admitting the patient in ICU for monitoring purpose only.

Complications developed in ICU. A total of 16 patients developed significant complications during their stay in ICU. In the majority of these patients, triggering events, which caused such complications probably started well before their ICU admissions. Respiratory failure developed in 4 patients. Two patients developed Acute Respiratory Distress syndrome (ARDS), one due to sepsis and other due to aspiration. Both required IPPV. Cardiac failure developed in 4 patients. All of them received massive fluid (crystalloid, colloid, blood and its products) transfusion to treat intra and postpartum hemorrhage. Three patients under went emergency CS and one patient delivered vaginally. Preoperatively, one patient had peripartum cardiomyopathy while other 2 were medically fit. All of them received multiple doses of

uterocostrictor (Syntocinon, ergometrine, and prostaglandin) drugs. Four patients developed acute renal failure in ICU. They underwent CS with severe preeclampsia (2), chronic renal failure (1) and severe hemorrhage (1). Diseases causing hypoperfusion of kidneys make them very vulnerable to develop acute failure after even moderate hemorrhage. These patient developed renal complication despite direct central venous and arterial monitoring, intravenous fluid replacement and dopamine infusion (renal dose). Three of them required hemofiltration. Three patient developed septic shock in ICU. One patient after vaginal delivery admitted to ICU due to sepsis. Other 2 patients went into septic shock after massive hemorrhage. All of them required ventilatory and inotropic support. Two patients developed neurological complication after admission to ICU. One eclamptic lady admitted after emergency CS admitted in ICU due to decreased level of consciousness, had generalized convulsions 4 hours after the operation. The other was a 25 years old lady who was diagnosed as encephalitis, underwent emergency caesarean section, delivered a live baby and admitted to ICU for neurologic observation. After 6-days stay in ICU she was declared brain dead. This was the only mortality out of 99 patients admitted to ICU. Previously reported mortality in obstetric patients admitted to ICU by Tang et al⁹ 4%, Kilpatric and Matthay⁴ 12%. Collop and Sahn³ analyzed 20 obstetric admissions to ICU, reported 20% mortality. Where as Lapinsky et al¹⁶ reviewed 65 critically ill obstetric patients admitted to ICU, reported no maternal death. In UK, approximately one third of maternal deaths were recorded as requiring intensive care.¹⁵

Despite excellent maternal out come in our study, approximately one-sixth of total obstetric ICU admission developed significant complications. The quality of care before and after admission to ICU should be reviewed so as to reduce the complications in ICU.

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