



Admissions to Intensive Care Unit in Pregnancy – A Six Year Experience

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Abstract

Purpose: To characterize obstetric patients admitted to the Intensive-Care-Unit (ICU) during pregnancy and delivery, and to compare them to control pregnancies.

Methods: A retrospective study on all pregnancies delivered between 2011 and 2016 and admitted to the cardiac and general ICU was conducted. Variables assessed included maternal characteristics, data regarding delivery and data from ICU.

Results: Seventy three patients (0.096%) were admitted to the general (n=42) and cardiac (n=31) ICU during pregnancy or immediately following delivery. The mean gestational-age at delivery was 36.1 weeks. 79.5% delivered by cesarean-section. The main causes of admissions during pregnancy were hypertensive disorders, while following delivery were cardiovascular, infectious and bleeding disorders. Significantly more patients in the general-ICU needed mechanical-ventilation compared to the patients in the cardiac-ICU. Hospitalization in the general-ICU was significantly longer than in the cardiac-ICU (p=0.004). No significant differences were found between pre-partum and postpartum patients in their admission to the general-ICU compared to the cardiac-ICU. There were four cases of neonatal deaths (5.5%). There were no differences in the neonatal outcomes between the patients admitted in the general-ICU and the cardiac-ICU.

Conclusion: Rapid administration of treatment and coordinated multidisciplinary management may improve the clinical outcome of these high-risk populations.

Keywords: Intensive care unit; Pregnancy; Cardiac; Cesarean section

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Introduction

Admission of pregnant and postpartum women to the Intensive Care Unit (ICU) poses a challenge to the health care providers due to the special physiological changes that occur during pregnancy and delivery, fetal considerations and the obstetric severe complications that may be life threatening to the otherwise healthy patient. A coordinated multidisciplinary team including obstetricians, intensivists, anesthesiologists, pediatricians and pharmacists is necessary for optimal care of both the severe patient and also her fetus in cases of antenatal ICU admission [1]. Severe medical compromise, resulting in admission of the pregnant patient to the Intensive Care Unit (ICU), occurs in 0.07% to 0.9% of deliveries [2-6]. The reasons for ICU admissions are mainly hypertensive disorders, obstetric hemorrhage and infections [2-6]. In the last two decades several authors described their experience with obstetric patients hospitalized in the ICU both in western and in third world countries [3-5,7,8]. Our objective was to characterize all obstetric patients admitted to the ICU during pregnancy and delivery, with emphasis on the indication, risk factors, course and outcomes of the patients and the fetuses, and to compare them to the women who delivered without the need of admission to the ICU.

Materials and Methods

We retrospectively reviewed the retrieved data on all pregnant women hospitalized and followed at The Chaim Sheba Medical Center (≈10,000 deliveries per year) in Israel, who were admitted to the ICU, during a 5 year period (January 2011, December 2016). Approval for the study was granted by the Institutional Review Board of The Chaim Sheba Medical Center.

Study group

The charts of all pregnant women hospitalized in the general ICU and the cardiac ICU were

Table 1a: Characteristics of the patients admitted to the general ICU and the cardiac ICU.

	All (n=73)	General ICU (n=42)	Cardiac ICU (n=31)	P value
Maternal age	33 (31-38)	34.5 (31-39)	33 (36.5)	0.247
BMI	27.5 (24.2-32.5)	26.4 (24.2-31.2)	30.5 (23.7-35.2)	0.381
Nulliparity	3 (4.1%)	1 (2.4%)	2 (6.5%)	0.123
Twin pregnancies	20 (27.4%)	14 (33.3%)	6 (19.4%)	0.186
Pre-partum admission	14 (19.2%)	8 (19%)	6 (19.4%)	0.974
Gestational age at delivery	36.1 (32.5-37.2)	34.7 (32.2-37.5)	36.5 (34.4-37.2)	0.219
Birth weight	2300 (1703-2870)	2042 (1655-2845)	2430 (1952-2875)	0.267
Male Gender	32 (45.1%)	20 (48.8%)	12 (38.7%)	0.746
Mode of delivery - Spontaneous Vaginal	13 (17.8%)	11 (26.2%)	2 (6.5%)	0.035
Mode of delivery - Cesarean	58 (79.5%)	29 (69%)	29 (93.5%)	
Mode of delivery - Operative Vaginal	2 (2.7%)	2 (4.8%)	0 (0%)	
Apgar 1	9 (8-9)	8.5 (5-9)	9 (9-9)	0.01
Apgar 5	10 (9-10)	10 (8-10)	10 (9-10)	0.167
Apgar 5 min <8	13 (17.8%)	7 (16.7%)	6 (19.4%)	0.767
Neonatal death	4 (5.5%)	4 (9.5%)	0 (0%)	0.132
Mechanical Ventilation	21 (28.8%)	19 (45.2%)	2 (6.5%)	<0.001
Days from admission to delivery	28 (19-52)	44 (16-60)	25 (19-44.5)	0.15
Days from delivery to ICU	26 (12-49)	42 (8-58)	22 (18-42)	0.175
Days in ICU	2 (1-4)	2.5 (2-6)	1 (1-3.5)	0.004

Continuous variables are represented as median (IQR) and categorical variables are represented as number (%). P-values were calculated using Mann-Whitney U test, Chi-square test or Fisher exact test as appropriate

examined. Data included maternal age, BMI, gestational age at delivery, mode of delivery, birth weight, Apgar scores, causes of admission to the ICU, need for mechanical ventilation, and days of hospitalization.

Control group

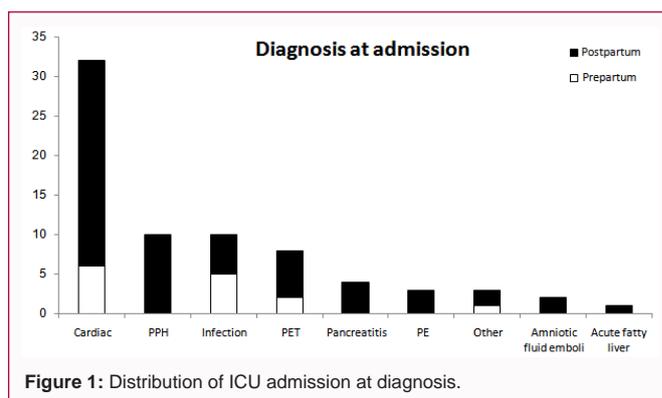
Data on all patients delivered at The Chaim Sheba Medical Center during the study period were retrieved from a computerized hospital database. Comparison was made between admission to the general and the cardiac ICU, as well as between pre-partum and postpartum admission to the ICU.

Statistical analysis

Q-Q plots were used to assess for normality. Continuous variables were described as mean (STD) or median (IQR). Comparison of continuous variables between the two groups was conducted using Mann-Whitney U test. Chi-square or Fisher exact test were used for comparison of categorical variables as appropriate. Significance was accepted at $P < 0.05$. Statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (IBM SPSS v.20; IBM Corporation Inc, Armonk, NY, USA).

Results

During the study period there were 75932 deliveries in our medical center. Seventy three patients (0.096%) were admitted to the ICU during pregnancy or immediately following delivery. The characteristics of the patients admitted to the general ICU (n=42) and the cardiac ICU (n=31) is presented in Table 1a. Most patients delivered near term (mean 36.1 weeks gestation), mainly by cesarean section (79.5%). Significantly more patients in the general ICU delivered vaginally compared to the patients in the cardiac ICU who delivered mainly by cesarean section. Significantly more patients in the general ICU needed mechanical ventilation compared to the



patients in the cardiac ICU. Hospitalization in the general ICU was significantly longer than in the cardiac ICU ($p=0.004$). There were no differences in the neonatal outcomes (birth weight, gender, 5 min Apgar scores) between the patients admitted in the general ICU and the cardiac ICU. There were four cases of neonatal deaths (5.5%), all in patients admitted in the general ICU, not statistically significant. No significant differences were found between pre-partum and postpartum patients in their admission to the general ICU compared to the cardiac ICU. Most patients were admitted to the ICU following delivery. The comparison between patients that were admitted to the ICU prenatally (n=14) to the patients admitted following delivery (n=59) is presented in Table 1b. More postpartum patients needed mechanical ventilation. The reasons for admissions in the ICU during pregnancy or following delivery are presented in Figure 1. The main causes of admission to the ICU during pregnancy were hypertensive disorders, while the main causes of admission to the ICU following delivery were cardiovascular, infectious and bleeding disorders. The comparison between the study population admitted to the ICU and

Table 1b: Comparison between patients that were admitted to the ICU prenatally to patients admitted following delivery.

	Pre-partum (n=14)	Postpartum (n=59)	P value
Maternal age	34 (33-38)	33 (30-37.5)	0.235
BMI	26.3 (24.4-31.2)	29.1 (24-32.5)	0.619
Nulliparity	1 (7.1%)	2 (3.4%)	0.312
Twin pregnancies	6 (42.9%)	14 (23.7%)	0.187
Gestational age at delivery	34.1 (32.2-36.5)	36.2 (33.1-37.4)	0.169
Birth weight	2052 (1600-2610)	2335 (1703-2945)	0.344
Male Gender	7 (50%)	25 (43.9%)	0.718
Mode of delivery - Spontaneous Vaginal	3 (21.4%)	10 (16.9%)	0.739
Mode of delivery - Cesarean	11 (78.6%)	47 (79.7%)	
Mode of delivery - Operative Vaginal	0 (0%)	2 (3.4%)	
Apgar 1	9 (9-9)	9 (7-9)	0.17
Apgar 5	10 (9-10)	10 (9-10)	0.842
Apgar 5 min <8	3 (21.4%)	10 (16.9%)	0.705
Neonatal death	1 (7.1%)	3 (5.1%)	1
Mechanical Ventilation	1 (7.1%)	20 (33.9%)	0.054
Cardiac ICU	6 (42.9%)	25 (42.4%)	0.974
Days in ICU	2.5 (2-5)	2 (1-4)	0.266

Table 2: Comparison between the women admitted to the ICU and control group of all deliveries.

	ICU (n=73)	Control (n=75932)	p
Maternal age	33 (31-38)	32 (29-36)	0.01
BMI	27.5 (24.2-32.5)	27.5 (25.1-30.7)	0.908
Gestational age at delivery	36.1 (32.5-37.2)	39 (38-40)	<0.001
Birth weight	2300 (1703-2870)	3140 (2760-3475)	<0.001
Mode of delivery - Spontaneous Vaginal	13 (17.8%)	49885/75932 (65.7%)	<0.001
Mode of delivery - Cesarean	58 (79.5%)	21454/75932 (28.3%)	<0.001
Mode of delivery - Operative Vaginal	2 (2.7%)	4593/75932 (6%)	
Preterm delivery <37 weeks	47 (64.4%)	10820/75932 (14.2%)	
Preterm delivery <34 weeks	26 (35.6%)	3164/75932 (4.2%)	<0.001
Preterm delivery <32 weeks	12 (16.4%)	1807/75932 (2.4%)	<0.001
Apgar 1	9 (8-9)	9 (9-9)	<0.001
Apgar 5	10 (9-10)	10 (10-10)	<0.001
Apgar 5 min <8	13 (17.8%)	1444/75591 (1.9%)	<0.001

the control group of all deliveries in our medical center during the study period is presented in Table 2. Significantly more patients who were admitted to the ICU delivered by cesarean section, had a preterm delivery, resulting in significantly lower birth weight, with lower Apgar scores.

Discussion

The present study demonstrated that 0.096% of all pregnancies were admitted to the ICU, most of them due to cardiovascular, infectious or bleeding complications. The majority of admissions to the ICU were in patients following delivery. This rate of admission in the ICU reported in the present study was similar to previous studies of 0.07% to 0.9% [5,9-14]. Most studies agreed that bleeding complications and hypertensive disorders were the main causes of obstetric admissions to the ICU, with a rate that ranged from 21% to 76% for hypertensive disorders and 15% to 33% for bleeding [5,8,14-18]. Indeed, a cross-sectional study performed by the World

Health Organization, showed that preeclampsia or eclampsia and postpartum hemorrhage were the main reasons for maternal death or maternal near-miss. Although preeclampsia complicates 3% to 8% of all pregnancies [19,20], it is a leading cause of maternal death responsible to 70,000 maternal deaths annually [21]. Severe complications such as HELLP syndrome (hemolysis, elevated liver enzymes and low platelets) and eclampsia may result in maternal death mainly due to renal failure, coagulopathy, pulmonary and cerebral edema, placental abruption, hepatic hemorrhage, and hypovolemic shock [22,23]. Pollok reported that hypertensive disorders of pregnancy were the most prevalent indication for ICU admission (0.9 cases per 1,000 deliveries). We found a similar rate of admission to the ICU due to bleeding complications, but a relative lower rate of hypertensive disorders. This may be explained due to a special recovery unit that is part of the recovery room of the obstetrical operation room that has a team of anesthesiologist and a nurse specialized in intensive care along with facilities of intensive

care treatment. Patients who need mechanical ventilation or a long intensive care follow up of more than 24 h are transferred to the general intensive care. Otherwise they receive full treatment in this special recovery unit. The advantages of this unit are a combined close therapy and follow-up by both the obstetricians and the intensive care team, and reduction of admissions to the general ICU. In the present study 31 patients (42.5%) were admitted to the cardiac ICU, more than reported before. Our hospital is a tertiary center to which many high risk patients, including cardiac patients, are referred for delivery. Many of these patients are electively admitted to the cardiac ICU before or following delivery for better monitoring, treatment and follow up, resulting in the increased proportion of admissions to the cardiac ICU. Other causes of admission to the ICU detected both in our study and in the literature included pancreatitis, acute fatty liver and amniotic fluid emboli. Significantly more patients admitted to the ICU delivered preterm, resulting in significantly lower birth weight and significantly reduced Apgar scores. All four cases of neonatal deaths occurred in patients admitted in the general ICU, probably due to the more severe maternal condition in these patients, resulting in neonatal death. However, this was not found statistically significant, probably due to the low rate of neonatal death.

The significantly high rate of cesarean sections in the patients admitted to the ICU before delivery may be a result of the severe critical maternal condition posing increased risk to the fetus, necessitating cesarean section. Postpartum admissions to the ICU occur in patients whose medical condition deteriorates and need rapid delivery by cesarean section, followed by admission to the ICU, or complicated cesarean sections resulting in severe maternal morbidity necessitating admission to the ICU. Mirghani and Keizer also reported a 78.4% of cesarean deliveries. Most patients were admitted to the ICU following delivery. Similarly, Pollok found that the majority of all ICU admissions occurred during the postpartum period. The rate of antepartum admission in previous studies ranged between 22.1% and 62.4%. Interestingly, Özçelik reported that most patients admitted antepartum were primiparous (88.8%), whereas those admitted postpartum were multiparous (64.6%) [25]. Pollok reported that half of all admissions were nulliparous patients. They associated nulliparity to increased risk of hypertensive disorders of pregnancy. We found no differences in parity between antepartum and postpartum admissions to the ICU. A possible explanation is the reduced rate of hypertensive etiology for the admissions in the ICU discussed earlier. Although the mean maternal age was higher in the ICU patients compared to the control group, the mean maternal age was 33 (not advanced maternal age). Similarly, Pollok reported that advanced maternal age is not uniformly associated with ICU admission. They found a median age of 30 years with only 22% of women \geq 35 years, consistent with birth age patterns in developed countries. The present study did not find differences in the maternal age in patients admitted to the cardiac ICU and the general ICU, probably because many patients who were admitted to the cardiac ICU had congenital heart diseases. Significantly more patients admitted to the general ICU needed mechanical ventilation compared to those admitted to the cardiac ICU. Similar rates of need of mechanical ventilation were reported before (44.4%). These differences may be explained by semi-elective admission of cardiac patients to the cardiac ICU near delivery or following delivery in order to provide them better monitor, treatment and follow up, thus reducing complications that may result in mechanical ventilation. Another reason is the special recovery unit in the obstetrical operation room in which intensive

care treatment is given to many of the critically ill patients, while patients requiring mechanical ventilation are admitted to the general ICU. The duration of hospitalization in the ICU of the patients in the present study was two days, similar previous report by Mirghani. No differences were found between the duration of hospitalization in the antepartum admissions compared to the postpartum admissions to the ICU. Maternal death, although a rare event in developed countries, is a tragic outcome of pregnancy with an incidence of 5-10 per 100000 deliveries [26]. We observed no maternal deaths in our study. The improvements of health public systems, better access to healthcare and improved intensive care resulted in a decrease in the incidence of maternal mortality over the years from 25% in 1992 [27], to 2.3% in 1999. Early diagnosis of critical medical conditions resulting in the rapid administration of treatment and coordinated multidisciplinary management, whether in the ICU or in special targeted units in the obstetrical department, may improve the clinical outcome of these high risk populations.

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