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Characteristics of Obstetric Patients Referred to Intensive Care in an Australian Tertiary Hospital.

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Abstract

Background: The low mortality rate of 8.4 deaths per 100 000 women giving birth in Australia is well described; however, less is known about the spectrum of morbidity evident in pregnant and postpartum women admitted to an intensive care unit.

Aim: A detailed description of the demographics, comorbidities, diagnoses and interventions of pregnant and postpartum women admitted to an Australian intensive care unit (ICU).

Materials and Methods: A retrospective observational study was conducted in a large metropolitan hospital co-located with a quaternary-level maternity hospital. The participants were women admitted to intensive care between 1 January 2007 and 30 June 2009 who were pregnant at any gestational age, or within 6 weeks postpartum.

Results: Two hundred and forty-nine women were admitted to ICU within the study period constituting 19% of all ICU admissions. The main reasons for admission were hypertensive disease of pregnancy and obstetric haemorrhage. The median (range) age was 32 (17–51) years, and ICU duration was 32 (8–228) h. The median APACHE III-J severity of illness score was 32 (8–80). Almost one-quarter of admissions could be classified as primarily observational. The most common interventions in ICU were invasive arterial pressure monitoring, central venous access with pressure monitoring and magnesium infusions. One-fifth of admissions were invasively ventilated.

Conclusion: A substantial number of pregnant and postpartum women admitted to ICU did not receive interventions typical of other critical illness, such as mechanical ventilation, inotropes or renal replacement therapy. This confounds the use of an ICU admission as a measure of maternal morbidity.

Key words: intensive care, critical care, pregnancy, pregnancy complications, puerperium.

Introduction

The demographic characteristics of the Australian childbearing population are changing, with mothers now being older and experiencing more co-morbidities than previously[1]. As a result, increasing numbers of obstetric patients may be admitted to intensive care units (ICU) during pregnancy or the postpartum period. Australia's health quality authorities have a distinguished history of monitoring maternal mortality[1]. However the spectrum of women receiving critical care support associated with maternal morbidity is incompletely documented, with few Australian studies in the last two decades reporting these characteristics[2-5].

A number of international cohort studies provide recent descriptions of the pregnant and postpartum population admitted to intensive care units. These studies show heterogeneity in the definition of an obstetric patient, and variation in the criteria for admission to ICU which confound international and national comparisons of illness severity, treatment modalities and models of care[3]. As well, there is variation in the level of completeness of reported data on ICU resource utilisation and ICU length of stay in the obstetric cohort[6].

Future planning of service delivery needs for the Australian obstetric cohort will be aided by knowledge of the demographic and clinical characteristics specific to these patients. The aim of this study was to describe the main diagnoses, comorbidities, specific ICU interventions and outcomes of the pregnant and postpartum population who were referred to one Australian metropolitan tertiary intensive care unit during a recent 30 month period.

Methods

A retrospective observational study was undertaken of women admitted to the Intensive Care Unit (ICU) at the Mater Adult Hospital (MAH), Brisbane. The MAH ICU was recently expanded to an 11 bed tertiary unit and shares a campus with the Mater Mothers Hospital (MMH). The MMH is a large quaternary maternity hospital that caters for both public and privately insured patients, with over 9000 deliveries per year. Referrals are received from throughout Queensland, interstate and international locations[7]. The MMH has no High Dependency Unit (HDU) and due to its physical proximity all women who required high acuity care were transferred to the MAH ICU. Consecutive women who were pregnant (at any gestational age), or postpartum (within 6 weeks) and admitted to the adult ICU for any duration between 01 January 2007 and 30 June 2009 were included in the study.

The cohort was identified by interrogation of three overlapping data sources, namely the departmental list of ICU admissions, the hospital electronic record compiled by Diagnosis Related Group codes and the Australasian Outcomes Research Tool for Intensive Care Adult Patient Database. The medical record of any woman whose diagnosis was unclear from the data sources was retrieved and reviewed to ensure complete identification of the patient cohort.

All research data were extracted manually from each hospital patient record by one author using a data dictionary (appendix 1) and case report form (CRF appendix 2) containing 93 variables. The CRF was composed in part of data fields identified as relevant by previous scientific publications. Research data included patient demographics, comorbidities, diagnoses, pregnancy and delivery details including

assisted reproduction, health insurance status, routine haematological and biochemical results and intensive care severity of illness scores (Acute Physiology and Chronic Health Evaluation [APACHE] II + III-J) and interventions within ICU.

The Mater Health Services Human Research Ethics Committee (HREC) assessed this study to be a quality assurance activity exempt from HREC review. In observance of the ethical requirements all data were kept in a locked office accessible only to the investigators.

Statistical analysis

Data were transcribed to a Microsoft Excel spreadsheet and analysed after importation into Stata version 12[8]. Continuous variables were summarized as mean and standard deviation if approximately normal, otherwise as median, inter quartile range (IQR) and range. Categorical variables were summarized as proportions.

Results

During the 30-month study period 249 of 21067 (1.2%) women admitted to the MMH for antepartum, delivery or postpartum care were transferred to the adult ICU at some point in their hospital stay. This is equivalent to 1180 ICU referrals per 100 000 obstetric patients. These 249 obstetric patients constituted 19% of the 1310 admissions to MAH ICU during the study period. Five women were admitted twice and 34 (13.7%) women were transferred from an off-campus hospital.

The median age of the women in the cohort was 32 years (IQR: 27-36; range: 17-51; mean 31.5, standard deviation 6.25) and they remained in ICU a median of 32 hours

(IQR: 21-47; range: 8-222). The median body mass index was 23.3 kg/m^2 (IQR: 21-29; range: 17-51) although these data were missing for 58 women. The median APACHE III-J score was 32 (IQR: 26-39; range: 8-80). Among the 34 recorded countries of maternal birth, the most frequent were Australia (n = 186), New Zealand (n = 12), England (n=7) and India (n = 6). No women died in ICU, although 19 women (7.6%) had an associated stillbirth or neonatal death.

The majority of women, 230/249 (92%), were admitted postpartum while antenatal admissions constituted 5% (12/249) (Table 1). Three women were admitted due to complications from a miscarriage or ectopic pregnancy, and a further four women delivered while an ICU inpatient. The most common mode of delivery was urgent or emergency caesarean section (57%). The median gravidity was 2 and over half, (51%), of the women were primiparous.

The three most common comorbidities experienced by this cohort were, in decreasing order of frequency, any form of documented psychiatric illness, diabetes mellitus and any form of cardiac disease (Table 2)

The majority of admissions (n = 222, 89%) were unscheduled and urgent or emergency in nature, while 27 women were admitted electively post operatively. The most common primary obstetric-related diagnoses were hypertensive disease of pregnancy and obstetric haemorrhage (Table 3). Of the 68 women admitted to ICU with obstetric haemorrhage almost half, 31, underwent an emergency hysterectomy. Of these patients, 23 had a history of previous caesarean surgery.

The distribution of clinical interventions received in ICU is summarised in Table 4. The most common was invasive arterial pressure monitoring with an intra-arterial catheter

while central venous catheters were less common. Mechanical ventilation occurred in 46 (18%) patients, with no episodes of non-invasive ventilation. In those women who were ventilated the median duration was 18 hours (IQR: 5-26 h; range: 1-180 h).

The Haemoglobin (Hb) nadir during ICU admission was a median of 102 g/L (IQR: 86-113) with a range of 51-160 and the median lowest platelet count was 163 $10^9/L$ (IQR: 102-225; range: 20-476). The median peak alanine transaminase recorded in ICU was 25 U/L (IQR: 17-51; range: 3-3227) and the median lowest plasma sodium was 134 mmol/L (IQR: 132-135; range: 106-143). The median highest creatinine was 64 micromole/L (IQR: 53-81) with a range of 32-417.

Discussion

Consistent with international epidemiologic reports over several decades[6;9;10], obstetric patients were most commonly admitted to ICU in association with hypertensive diseases of pregnancy or in the context of obstetric haemorrhage. These two leading indications for critical care support of obstetric patients are also confirmed by other Australian studies[2;3;5], however the frequency of admission associated with hypertensive diseases of pregnancy in our current study (41%) may be greater than in other Australian and overseas reports. As well, this proportion has increased compared with previous reports from our institution, where hypertensive diseases were deemed responsible for 24% of admissions in 1991[4] and 28% of admissions in the period 1994-1997[11] .

Although admission to ICU may appear to be an epidemiologically useful marker of maternal morbidity, our data illustrate that local hospital clinical service options may confound such an approach. In recent years, the rate of obstetric admissions to ICU at our institution has exceeded many of those reported in international data derived from

multiple countries[6], including the United Kingdom[12] and the United States of America[9]. This relatively high local ICU admission rate included a notable proportion of women with pregnancy-associated hypertensive disease who had no specific ICU-related intervention apart from invasive arterial pressure monitoring and/or a magnesium sulphate infusion..

This management strategy may be influenced by many factors. The availability of ICU beds has been described to influence the case mix of admitted patients[13]. MMH has no HDU but from 2007 there was improved access to ICU beds associated with the MAH ICU capacity expansion. A recent report from Hong Kong also indicates the threshold for an obstetric patient admission to ICU may be changing, with an increasing trend to admit women with pregnancy related hypertensive diseases to ICU primarily for precautionary monitoring purposes.[14]

Another influence potentially leading to obstetric ICU referrals may be the rate of repeat caesarean section, which is accompanied by an increased risk of haemorrhage requiring peripartum hysterectomy. [15;16]

Maternal age may also be a factor leading to ICU referral, as extremes of maternal age are known to adversely influence both foetal and maternal outcomes[17]. The mean age of our cohort, at almost 32 years, was greater than the national average of the child bearing population, 30 years, in 2008. The average age of the Australian child bearing population increased 7.5% between 1991 and 2009[18] and data from the state of Queensland mirror the Australian national statistics[19]. Over the last 20 years the proportion of women giving birth in Queensland at age 35 years or older has increased from 7.7% to 19.3%. The proportion of women in our intensive care cohort aged 35

years or greater was 30% (N=75/249), suggesting that older child bearing women may have an increased need for ICU services.

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Improved documentation of maternal co-morbidities in this cohort is important in view of suggestions that maternal deaths are increasingly associated with pre-existing disease[20] In our cohort, smoking status, body mass index and use of assisted reproduction technology were all incompletely recorded. As well, limited specificity with respect to the psychiatric diagnosis of many patients was noted, even though serious psychiatric conditions are associated with increased rates of obstetric and neonatal complications[21].

The recognition of women admitted to ICU with multiple relevant clinical diagnoses is indicative of the complexity associated with some obstetric patients, supporting their referral to centres with experienced multidisciplinary teams. Early identification of women at risk is important considering the geographical challenges that impact on advanced health care delivery in Australia.

The proportion of interventions per patient in our study may be lower than described in a recent Victorian study[3], despite these two cohorts having similar APACHE III-J scores, admission durations and shared zero mortality rates. . These variations suggest an admission to ICU may not be a suitable metric to assess severe maternal morbidity in an advanced health service such as that of Australia. . In this context, it is timely that the Australasian Maternity Outcome Surveillance System (AMOSS) is considering prospectively examining ICU admissions, although inconsistent practices, including variation in the rates of caesarean section[22], may influence the utility of these data.

Strengths and Limitations

This study was strengthened by being conducted within a very large quaternary referral obstetric hospital with over 9000 deliveries per year, but limited by its single centre retrospective design. We found the majority of missing documentation involved confirmation of some form of assisted reproduction or the patient's smoking status. As well, body mass index was unreliably documented despite its association with obstetric outcome[23]. Future completion of a standardised electronic medical health record relevant to the obstetric population may enhance the completeness and quality of data collection.

Conclusion

This manuscript describes the clinical characteristics and outcomes of a large obstetric patient cohort admitted over a 30 month period ending June 2009 to an ICU on the same campus of an Australian quaternary obstetric teaching hospital . Notable observations included the relatively advanced age of the child bearing population, the imprecision with which certain comorbidities were recorded and the rate of admission to ICU for precautionary physiological monitoring only. Observations in our single centre question the value of using an Australian ICU admission as a sufficient surrogate for serious maternal morbidity.

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Table 1: Obstetric details (N = 249)

Patient characteristic	
Gravidity† , n, median [IQR]; range	2 [1-3]; 1-10
Parity† , n, median [IQR]; range	0 [0-2]; 0-6
Gestational age*, week, median; range	
postpartum	36 [32-38]; 19-41
antepartum	28 [22-34]; 10-39
Ectopic pregnancy, n (%)	2 (0.8)
Miscarriage, n (%)	1 (0.4)
Antenatal, n (%)	12 (5)
Previous Caesarean section, n (%)**	73 (30)
Assisted reproductive technology (of any type): n/180‡	29 (16)
Delivery, n (%)	
spontaneous vaginal	23 (9.2)
operative vaginal	19 (7.6)
elective caesarean	49 (20)
urgent or emergency caesarean	143 (57)

†missing data for 1 woman

*missing data for 2 women

‡missing data for 69 woman

**missing data for 4 women

Table 2: Comorbidities of obstetric patients admitted to ICU (N = 249)

Comorbidity	*n (%)*
Psychiatric illness of any type	46 (18)
Diabetes mellitus	
gestational	17 (6.8)
all other diabetes	7 (2.8)
Cardiac disease	
congenital	14 (5.6)
acquired	11 (4.4)
Hypertension	
chronic	7 (2.8)
chronic + pre-eclampsia	14 (5.6)
Thrombosis	13 (5.2)
Thyroid disease or thyroxine therapy	11 (4.4)
Autoimmune	9 (3.6)
Malignancy of any kind	7 (2.8)
Smoking[t]	65 (40)

[t]missing data in 86 women, making denominator 163

Table 3: Reasons for ICU admission

	n/249 (%)
Obstetric	183 (73.0)
Hypertensive diseases of pregnancy[†]	103 (41.0)
Obstetric haemorrhage	68 (27.0)
Puerperal sepsis	7 (2.8)
Other obstetric[‡]	5 (2.0)
Non-obstetric	81 (33)
Respiratory	23 (9.2)
Cardiac	21 (8.4)
Sepsis	10 (4.0)
Analgesia – related complication	9 (3.6)
Other[§]	18 (7.2)

15 women were admitted with more than one major obstetric diagnosis.

[†] preeclampsia/eclampsia/HELLP syndrome

[‡]Other obstetric diagnoses included uterine rupture and peripartum cardiomyopathy

[§] Other non obstetric diagnoses included pheochromocytoma, salbutomal overdose and thrombotic thrombocytopenic purpura

Table 4: ICU therapies (N = 249)

Intervention	n (%)
Arterial catheter	174 (70)
Magnesium sulphate infusion †	90 (36)
Central venous catheter	56 (22)
Mechanical ventilation	46 (18)
Cardiac monitoring (specific cardiac indication)	22 (8.8)
Inotropes/vasopressors	11 (4.4)
Plasmapheresis	3 (1.2)
Renal replacement therapy	2 (0.8)
Red cell transfusion	
prior to ICU	60 (24)
in ICU	42 (17)
Total of 4 or more red cell units	50 (20)

Patients may have received multiple interventions

† 13/90 received no other critical care interventions in ICU