

# Obstetric Admissions to the Intensive Care Unit in a Tertiary Centre

Samantha Yeo<sup>1</sup>, Shephali Tagore<sup>2</sup>, Yim Chik Foo<sup>3</sup>, Tan Kok Hian<sup>2</sup>, Kenneth Kwek<sup>2</sup>

## ABSTRACT

**Introduction:** Obstetric complications relating to pregnancy, delivery and the puerperium can result in severe maternal morbidity and mortality. Understanding risk factors for obstetric WICU admissions may identify high-risk pregnancies and early intervention can improve maternal outcomes.

**Aims and objectives:** The primary aim of this study was to assess facility-based incidence, case fatality rate and risk factors for obstetric Women's Intensive Care Unit (WICU) admission.

**Methods:** Retrospective review of all WICU admissions for one year between January 2009 and December 2009 at KK Women's and Children's Hospital (KKH). Maternal characteristics and all variables concerning pregnancy and delivery were recorded, together with specific data associated with the ICU stay, including indication for admission and major interventions.

**Results:** There were 67 obstetric WICU admissions, with a hospital-based incidence of 5.6 per 1,000 deliveries. The vast majority of these admissions were postnatal. There was no maternal mortality during the period under review. The most frequent indications for postnatal WICU admission were hypertension during pregnancy (42.6%) followed by major obstetric haemorrhage (39.4%). The other factors associated with a higher risk for WICU admission, and hence severe maternal morbidity, were maternal age above 30, parity above two, and gestational age below 37 weeks.

**Conclusion:** Hospital-based incidence of WICU admission was 5.6 per 1,000 deliveries. Hypertension during pregnancy, major obstetric haemorrhage, maternal age above 30 and parity above two appear to be significant risk factors for WICU admission.

**Keywords:** ICU. Perinatal. Maternal morbidity.

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<sup>1</sup> Department of Obstetrics & Gynaecology,  
SingHealth

<sup>2</sup> Department of Maternal Fetal Medicine,  
KK Women and Children's Hospital

<sup>3</sup> Department of Women's Anaesthesia,  
KK Women's and Children's Hospital

For correspondence, please contact:

Dr Samantha Yeo

Address: KK Women's and Children's Hospital,  
100 Bukit Timah Road, Singapore 229899

Telephone: 96160670

Email: samantharachel.yeo@mohh.com.sg

## INTRODUCTION

Obstetric complications relating to pregnancy, delivery and the puerperium can result in severe maternal morbidity and mortality. The Women's Intensive Care Unit (WICU) is a specialized facility in KK Women's and Children's Hospital where complicated cases are monitored in a high-dependency and intensive care setting through a multidisciplinary approach involving obstetricians, intensivists, obstetric physicians and other sub-specialists.

The primary aim of this study was to assess facility-

base incidence, case fatality rate and possible risk factors for obstetric WICU admission.

## **MATERIALS AND METHODS**

The Women's Intensive Care Unit record log books were searched to identify all cases of obstetric intensive care admissions at KKH between 1 January 2009 and 31 December 2009. The history, examination, ultrasound results at presentation and discharge were reviewed, together with labor and operation notes, if any. Each case was assigned a unique Escrow number, and the corresponding patient's name and personal particulars were entered into a separate Excel database so as to maintain patient anonymity.

We recorded maternal characteristics (age, parity, and ethnicity), indication for admission, and major interventions. Our definition of major obstetric haemorrhage included one or more of the following: estimated blood loss of more than 1500 ml, need for blood transfusion, need for uterine packing, performance of uterine artery ligation, and Cesarean hysterectomy.

When more than one indication for WICU admission was present on admission, the case was classified according to the most serious condition, and secondary indications were recorded for future reference.

Parity was calculated including the current delivery. Any clinically significant pregnancy-associated conditions diagnosed prior to the patient's current hospital admission and WICU admission were considered significant antenatal events.

Denominator data for the number of births in KKH and reference values for possible risk factors for obstetric WICU admission were obtained from an electronic birth registry in KKH.

The case fatality rate was calculated by dividing the number of deaths by the total number of WICU admissions. Odds ratios and confidence intervals compared with the general pregnant population were calculated. Statistical analysis was

performed using Statistical Package for the Social Sciences (SPSS 17.0).

## **RESULTS**

Sixty-seven obstetric WICU admissions were identified during the 1-year period and reviewed. One woman was readmitted, after she developed peripartum cardiomyopathy and sepsis following her first discharge from the WICU. Case notes for all sixty-seven admissions were traced and reviewed. The characteristics of women admitted are shown in Table 1. The hospital-based incidence of obstetric WICU admissions was 5.6 per 1000 deliveries.

**Patient Characteristics:** The mean age of women admitted was 32.3 years, with the majority falling within the age group of 30-34 years of age (37.3%).

Ethnicity of women admitted was as follows: 48.5% Chinese, 24.2% Malay, 15.2% Indian, and 12.1% "Others". Of the eight women classified under "Others", two were Vietnamese, two were Thai, two were Burmese, one was Filipino and one was German.

The majority of women admitted (75.8%) had no previous medical problems, and only 24.2% had at least one chronic disease.

**Admission Characteristics:** The most frequent indication for postnatal WICU admission was hypertension during pregnancy (42.6%), with pre-eclampsia and eclampsia contributing 32.8% and 9.8% respectively of all obstetric WICU admissions (Table 2). Major obstetric haemorrhage (39.4%) was the next most frequent indication, occurring mainly as a delivery complication of cases with known placenta previa / adhesions. Amongst the six antenatal admissions, three (50.0%) were for severe pre-eclampsia, two for cardiomyopathy (33.3%) and one was for suspected pulmonary embolism with haemoptysis.

Of all the cases admitted to the WICU, 23.9% required assisted ventilation, 11.9% received massive transfusions, and 4.5% required inotropic support. Mean duration of WICU stay was 2.9 days. Only four

women stayed more than four days (6.0%).

**Pregnancy Characteristics:** Majority (63.6%) of women admitted experiencing at least one significant antenatal event prior to their current KKH admission. The specific antenatal events experienced are recorded in Table 3.

The mean gestational age on admission to WICU was 33.3 weeks, with 38.8% of women beyond 34 weeks amenorrhoea upon admission to WICU.

31.1% of the women admitted were primiparous, 29.2% were para 2, 23.9% were para 3, and 15% were para 4 and above.

Upon WICU admission, 24.2% of the women were previously unbooked at KKH. Only 3 women (4.5%) were totally unbooked and had received no formal antenatal care throughout their whole pregnancy. For those 13 women who were unbooked at KKH but transferred for complications in pregnancy, 12 had been followed up with a private obstetrician previously and one had been followed up at another restructured hospital. The remaining 50 women (75.8%) had all been seen at KKH prior to their WICU admissions. Of these, 12 women had booking visits only in their third trimester, although 9 of these 12 women had actually been followed up by a private obstetrician and requested to be transferred to KKH for their antenatal care and deliveries due to complications in their pregnancy, such as placenta previa major (77.8%) and fetal anomalies (22.2%). In total, 22 WICU cases (33.3%) had been transferred to KKH for management of pregnancy complications. The remaining three women were late bookers who had received no formal antenatal care throughout the first and second trimesters of their pregnancy.

Of the 64 women who eventually delivered during their admission to KKH, 90.6% were delivered via Caesarean section (Emergency, Crash or elective). 62.5% were Emergency Caesarean sections, 15.6% were crash Caesarean sections, and 12.5% were elective Caesarean sections. The remaining 6.3% delivered via normal vaginal delivery, and 3.1% delivered via assisted vaginal delivery.

**Outcome:** Following WICU discharge, most women (73.1%) were discharged to a step-down Post-Operative Area. 17.9% were transferred directly to a general ward, 3.0% were transferred to another government hospital for sub-specialty care (e.g. cardiac or renal support), 3.0% were discharged to the delivery suite and 3.0% were discharged home. At routine postnatal follow-up, 67.2% were well with no complaints. 10.4% reported minor complications still requiring follow up, 16.4% defaulted on their appointments and 6.0% were lost to follow up.

## **DISCUSSION**

KKH manages over 30% of all deliveries in Singapore, with over 12,000 deliveries in 2009. As all obstetric WICU admissions were enrolled and reviewed, our study is quite representative of the critically ill obstetric population in Singapore.

The obstetric WICU admission incidence of 5.6 per 1000 deliveries is slightly above the incidence of 2-4 per 1000 deliveries, as reported by Zeeman [1]. We practice a low threshold for WICU admission, and all women who are perinatally unstable are transferred to the WICU for monitoring and co-management by trained intensivists. Likewise, we feel it is appropriate to use WICU admission as an approximation for severe maternal morbidity. There was no case fatality rate in our series. This may reflect that referral to a tertiary centre, and a low threshold for admitting critically ill obstetric patients for aggressive WICU monitoring and appropriate interventions significantly reduces multiple organ failure and maternal mortality [1, 2].

In comparison to a similar case series [7] performed ten years earlier in our centre, we note that the incidence of WICU admissions has decreased only slightly, from 7.5 per 1000 admissions, to 5.6 per 1000 admissions. More significantly, there has been a shift in the main causes of obstetric morbidity - in Quah's study, hypertension and haemorrhage were responsible for 50% and 24% of obstetric admissions respectively. This translates to a 64% increase in severe maternal haemorrhage, and a 15% decrease in hypertension as major contributors to maternal morbidity within the same population of patients

over the course of ten years. This is in line with published results from other developed countries, which found a 64% decline in eclampsia rates in Canada from 2003 to 2007 [8], and increases of 46% to 297% in severe postpartum haemorrhage observed from 2000 to 2009 in British Columbia [9]. We attribute the drop in severe hypertension to earlier detection and intervention during the antenatal period, and the rise in WICU admissions due to postpartum haemorrhage to be due to more cases of previous Cesarean sections with adherent placentas and more aggressive monitoring and intervention postnatally [10-13]. Our study has also demonstrated a drop in maternal mortality in intensive care unit admissions from 1.3% in 1998 to 1999 [7] to 0% in 2009. Thus, whilst hypertension and major obstetric haemorrhage continue to be leading causes of maternal morbidity and mortality worldwide [1, 4-6], our data shows that recent improvements in combined obstetric and intensive care may have helped to reduce and prevent maternal mortality from such high-risk pregnancies.

The mean age of patients admitted as well as the percentage of patients who were free of chronic medical conditions is comparable with similar patient characteristics in the largest cohort study of WICU admissions, conducted in the Netherlands (32years vs. 32.3 years, and 75.8% vs. 72.0%). The average length of stay of 2.9 days is also comparable with the Dutch study [3].

Maternal age of 30 and above increases the risk of WICU admission, and hence severe maternal morbidity. A younger maternal age appears to be protective against WICU admission. Parity above two is a risk factor for WICU admission, and is consistent with the increasing risks of antenatal and delivery complications associated with increasing parity.

A woman's risk of being admitted to WICU appears to be higher if her gestational age is below 37 weeks on admission to WICU or at delivery directly prior to WICU admission. This is because timely delivery in an elective or emergency setting is important in

managing pre-eclampsia / eclampsia and delivery complications from known cases of placenta previa / adhesions [1].

Delivery via Caesarean section (either elective or emergency) is associated with a higher risk of severe maternal morbidity. This is probably confounded by the fact that Caesarean delivery is the mode of choice for most potentially unstable high-risk pregnancies and deliveries. Ideally, the indications for Caesarean delivery in the women enrolled in this study should have been analyzed in order to further exclude cases which were delivered via Caesarean section for reasons which were not absolutely medical.

Interestingly, whilst ethnicity could be identified as affecting an obstetric patient's risk of WICU admission in other Western and Asian studies [1, 7], women of different ethnicities in our study did not have significantly different risks of WICU admission and hence maternal morbidity. The main limitation of this study is the relatively small sample size, contributed by the relatively low number of absolute births (39,570 in 2009) in Singapore, as compared to other countries.

## **CONCLUSION**

The hospital-based incidence of WICU admission was 5.6 per 1,000 deliveries, with no case fatality. A low threshold for admitting critically ill obstetric patients for aggressive WICU monitoring and appropriate interventions may reduce multiple organ failure and maternal mortality. Hypertension during pregnancy, major obstetric haemorrhage, maternal age above 30 and parity above two appear to be significant risk factors for severe maternal morbidity.

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**Table 1: PATIENT CHARACTERISTICS**

	<i>n</i>	%	<i>n</i>	%	<b>ODDS RATIO</b>	<b>Confidence Interval</b>
			<i>Control, n=11903</i>			

**Age (years) *n*=66**

<b>Below 20</b>	0	0.0	449	3.8		
<b>20 – 29</b>	17	25.8	5372	45.1	<b>0.4218</b>	0.243 - 0.733
<b>30 – 34</b>	25	37.9	3695	31.0	<b>1.355</b>	0.822 - 2.231
<b>35 – 39</b>	21	31.8	1969	16.5	<b>2.354</b>	1.399 - 3.961
<b>40 and above</b>	3	4.5	418	3.5	<b>1.308</b>	0.409 - 4.183

**Ethnicity (*n*=66)**

<b>Chinese</b>	32	48.5	5526	46.4	<b>1.154</b>	0.711 - 1.872
<b>Malay</b>	16	24.2	3229	27.1	<b>0.860</b>	0.489 - 1.512
<b>Indian</b>	10	15.2	1406	11.8	<b>1.333</b>	0.679 - 2.619
<b>Others</b>	8	12.1	1742	14.6	<b>0.833</b>	0.397 - 1.751

**Chronic disease (*n*=66)<sup>a</sup>**

<b>No chronic disease</b>	50	75.8
<b>One or more chronic diseases</b>	16	24.2
<b>Asthma</b>	7	10.6
<b>Hypertension</b>	3	4.5
<b>Cardiovascular disease</b>	3	4.5
<b>Seizures</b>	2	3.0
<b>Diabetes</b>	2	3.0
<b>Others<sup>b</sup></b>	6	9.1

<sup>a</sup>Numbers do not add up to the total as some women suffered from more than one chronic disease.

<sup>b</sup>Anaemia, Thyroid disease, Migraines, Gastritis.

**Table 2: WICU ADMISSION CHARACTERISTICS**

	<i>n</i>	%
<b>Length of Stay (Days) <i>n</i>=66</b>		
1 day or less	12	17.9
2	35	52.2
3	11	16.4
4	5	7.5
5 to 10	2	3.0
10 to 20	1	1.5
More than 20	1	1.5
<b>Major WICU Interventions (<i>n</i> =67) <sup>a</sup></b>		
Assisted Ventilation	16	23.9
Massive Transfusion	8	11.9
Inotropic Support	3	4.5
<b>Diagnosis (<i>n</i>=67)</b>		
<i>Postnatal Cases (n=61)</i>		
Hypertension During Pregnancy	26	42.6
Eclampsia	6	9.8
Severe Pre-Eclampsia	20	32.8
Major Obstetric Haemorrhage	24	39.4
Cardiomyopathy	6	9.8
Sepsis / Infection	2	3.3
Others	3	4.9
<i>Antenatal Cases (n=6)</i>		
Severe Pre-Eclampsia	3	50.0
Cardiomyopathy	2	33.3
Haemoptysis	1	16.7

<sup>a</sup>Numbers do not add up as some women required more than one major intervention.



**Table 3: PREGNANCY CHARACTERISTICS**

	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<b>ODDS RATIO</b>	<b>Confidence Interval</b>
			<i>Control, n=11903</i>			

**Gestational Age on Delivery / WICU Admission (n=66)**

23 – 26 weeks	4	6.1	45	0.4	<b>17.001</b>	5.934 - 48.710
>26 – 30 weeks	9	13.6	107	0.9	<b>17.407</b>	8.403 - 36.060
>30 – 34 weeks	12	18.2	347	2.9	<b>7.401</b>	3.924 - 13.959
>34 – 37 weeks	25	37.9	2889	24.3	<b>1.903</b>	1.155 - 3.134
>37 weeks	16	24.2	8515	71.5	<b>0.127</b>	0.072 - 0.224

**Parity (n=66)**

1	20	30.3	5102	42.9	<b>0.580</b>	0.342 - 0.981
2	20	30.3	4054	34.1	<b>0.842</b>	0.497 - 1.425
3	16	24.2	1779	14.9	<b>1.821</b>	1.035 - 3.205
4	6	9.1	639	5.4	<b>1.763</b>	0.759 - 4.095
5	4	6.1	215	1.8	<b>3.507</b>	1.265 - 9.727
6 or more	0	0.0	114	1.0		

**Mode of Delivery (n=64)**

Caesarean Section	58	90.6	3595	30.2	<b>5.820</b>	2.507 - 13.508
Emergency (including crash)	50	78.1	2387	20.1	<b>14.238</b>	7.858 - 25.796
Elective	8	12.5	1208	10.1	<b>1.265</b>	0.602 - 2.659
Normal Vaginal Delivery	4	6.3	7664	64.4	<b>0.0369</b>	0.013 - 0.102
Assisted Vaginal Delivery	2	3.1	627	5.3	<b>0.580</b>	0.142 - 2.377

**Significant Antenatal Event (n=64) <sup>a</sup>**

No Significant Antenatal Event	24	36.4
One or More Significant Antenatal Event(s)	42	63.6
Hypertension	19	28.8
Placental Abnormalities	14	21.2
Placenta Previa Major	7	
Placenta Accreta	5	
Placenta Increta	1	
Placenta Percreta	1	
Diabetes	6	9.1
Multiple Gestation (Twins / Triplets)	4	6.1
Others <sup>b</sup>	3	4.5

**Booking Visit (n=66)**

Booked at KKH prior to WICU Admission	50	75.8
Booked in First Trimester	24	36.4
Booked in Second Trimester	14	22.2
Booked in Third Trimester	12	18.2
Unbooked in KKH prior to WICU Admission	16	25.2
Booked with Private Obstetrician	12	18.2
Booked at Other Restructured Hospital	1	1.5
Totally Unbooked	3	4.5

<sup>a</sup>Numbers do not add up to the total as some women experienced more than one significant antenatal event

<sup>b</sup>Respiratory symptoms, threatened miscarriage