ORIGINAL ARTICLE

Clinical characteristics and outcomes of obstetric patients admitted to the Intensive Care Unit: a 10-year retrospective review

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Objective To review the characteristics and health-related quality-of-life outcomes of obstetric patients admitted to the Intensive Care Unit.

Design Retrospective cohort study.

Setting A regional hospital in Hong Kong.

Patients Consecutive obstetric patients admitted to the Intensive Care Unit of Pamela Youde Nethersole Eastern Hospital from January 1998 to December 2007.

Results Fifty obstetric patients (mean [standard deviation] age, 31 [6] years; mean gestational age, 34 [9] weeks) were analysed. The most common obstetric cause of admission was postpartum haemorrhage (n=19, 38%), followed by pregnancy-associated hypertension (n=7, 14%). The commonest non-obstetric cause of admission was sepsis (n=7, 14%). The commonest intervention was arterial line insertion (n=33, 66%) and mechanical ventilation (n=29, 58%). Maternal mortality was 6% (n=3), while the perinatal mortality rate was 8% (n=4). The average Short Form–36 Health Survey scores of our patients were lower than the norm for the Hong Kong population of the same age and gender.

Conclusion Postpartum haemorrhage and pregnancy-associated hypertension were the most common causes of admission to our Intensive Care Unit. Overall mortality was low. Long-term health-related quality of life in discharged patients was lower than the norm of the Hong Kong population. Appropriate antenatal care is important in preventing obstetric complications. Continued psychosocial follow-up of discharged patients has to be implemented.

Introduction

Critically ill obstetric patients are a challenge to Intensive Care Unit (ICU) physicians. Not only are these patients young and usually otherwise healthy, but maternal mortality and morbidity are also important quality-assurance indicators.[1] In Hong Kong, as in other developed countries, obstetric patients only account for a small proportion (<2%) of ICU admissions, whereas the figure is up to 7% in India and Argentina,[2,3] and the maternal mortality ratio is also significantly higher in most such developing countries. In Hong Kong, the maternal mortality ratio has decreased from 125 per million births in 1946 to 3.5 per million births in 2005.[4,5] This change was very likely related to improved socio-economic conditions, availability of comprehensive antenatal, obstetric, anaesthetic and intensive care services, as well as access to more advanced treatment modalities.

According to the World Health Organization (WHO), "There is a story behind every maternal death or life-threatening complication. Understanding the lessons to be learnt can help to avoid such outcomes".[6] A better knowledge of the spectrum, characteristics, and outcomes of the diseases involving this group of patients is the first step towards achieving prevention and hence reduction of both maternal and neonatal morbidity and mortality.

The primary objective of the present study was to review the characteristics of the obstetric patients admitted to our ICU over a 10-year period, for both obstetric-related and non–obstetric-related causes. Our secondary objectives were to study health-related quality of life (HRQOL) outcome, and compare and contrast our findings with data from overseas.

Key words
Critical illness; Hypertension; Intensive Care Units; Postpartum hemorrhage; Pregnancy complications

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Methods

This was a retrospective cohort study of consecutive obstetric patients admitted to the ICU of Pamela Youde Nethersole Eastern Hospital over a 10-year period from January 1998 to December 2007. Our ICU was a 20-bed closed unit, which admits more than 1000 patients annually.

Patients admitted within the above period were identified using the computerised database of the Medical Records Department, the Clinical Data Analysis and Reporting System based on the admission codes "OBS" or "GYN". The admission books of our ICU were also utilised, so as not to miss any eligible patient. The patient records were then screened to ensure that when admitted, they were pregnant or within 42 days of termination of pregnancy.[7]

The protocol for the study was approved by the Ethics Committee of the Hospital and no patient intervention was involved.

Each patient record was reviewed in detail. Supplementary data were accessed through the hospital's patient database, the Clinical Management System, and the Acute Physiology and Chronic Health Evaluation (APACHE[7]) databases maintained by our department. The data retrieved for analysis included demographics (age, smoking and drinking status), co-morbidities, obstetric features (antepartum history, weeks of gestation, antenatal abnormalities, mode of delivery, vital signs, and Glasgow Coma Scale score) on admission to the ICU. The patient's disease severity was measured by the APACHE II score, the Simplified Acute Physiology Score (SAPS II[8]) and the Sepsis-related Organ Failure Assessment (SOFA[9]) score. The causes of admission to the ICU were classified as obstetric or non-obstetric. Obstetric disorders were defined as specific pregnancy-related conditions, which occurred during pregnancy or within 42 days in the postpartum period. Table 1[10-12] defines some of the obstetric disorders encountered in this study. Non-obstetric conditions were defined

入住深切治療室的產科病人的臨床特徵及治療結果：十年回顧研究

目的 回顧入住深切治療室的產科病人的臨床特徵及健康生活水平指數。

設計 隊列式回顧研究。

安排 香港一所地區醫院。

患者 1998年1月至2007年12月期間，所有入住東區尤德夫人那打素醫院深切治療室的產婦。

結果 分析了50位產婦的資料。病人平均年齡31歲（標準差：6歲），平均妊娠期34週（標準差：9週）。入住深切治療室而與孕產相關的原因，最普遍是產後出血（19人，38%），其次是妊娠高血壓（7人，14%）；至於與孕產不相關的原因，最普遍是膿毒症（7人，14%）。最常用的治療方法為動脈插管（33人，66%）及機械式通氣（29人，58%）。孕婦死亡率6%（3人），圍生兒死亡率8%（4人）。病人的SF-36健康生活水平指數較香港同年齡及性別的人口低。

結論 產科病人入住深切治療部的最普遍原因為產後出血及妊娠高血壓。整體死亡率偏低。病人的長期健康生活水平指數較香港一般人口低。需要進行適切的產前護理來防止與孕產相關的併發病，並應對出院病人進行心理支援和跟進。

TABLE 1. Definition of obstetric disorders[10-12]

Conditions	Definition*
Severe pre-eclampsia[10]	Hypertension >140/90 mm Hg or blood pressure increases of 30 mm Hg systolic or 15 mm Hg diastolic, and proteinuria >0.3 g complicated by one or more of the following: Hypertension >160/110 mm Hg Proteinuria >2 g/24 h or +++ on dipstix Oliguria <60 mL for 2 successive hours or <500 mL/24 h Epigastric or liver pain Headache and blurred vision Pulmonary oedema
Eclampsia	Any fitting in pregnancy that is unrelated to epilepsy
HELLP (haemolysis, elevated liver enzymes and low platelet count)	Haemolytic anaemia, hepatic cytolysis and thrombocytopenia: Bilirubin ≥17.1 μmol/L (haptoglobin ≤0.5 g/L or schistocytes + if available) and elevated AST ≥70 U/L or elevated GGT ≥70 U/L and platelet count <100 x 10^9/L
Amniotic fluid embolism[11]	Acute hypotension or cardiac arrest Acute hypoxia (dyspnoea, cyanosis, or respiratory arrest) Coagulopathy (laboratory evidence of intravascular coagulation or severe haemorrhage) Onset of all of the above during labour, caesarean section, or within 30 minutes of delivery No other clinical condition or potential explanation for the symptoms and signs
Peripartum cardiomyopathy[12]	Development of cardiac failure in the last month of pregnancy or within 5 months of delivery Absence of an identifiable cause for the cardiac failure Absence of recognisable heart disease before the last month of pregnancy Left ventricular dysfunction with LVEF <45% by echocardiography

* AST denotes aspartate aminotransferase, GGT γ-glutamyltransferase, and LVEF left ventricular ejection fraction

TABLE 2. Patient characteristics

Characteristics*	Data†
Age (years)	31±6
Medical history	
Smoker / ex-smoker / non-smoker	2 (4%) / 1 (2%) / 47 (94%)
Drug abuser	2 (4%)
Hepatitis B carrier	4 (8%)
Pulmonary tuberculosis	1 (2%)
Chronic rheumatic heart disease	1 (2%)
Uterine leiomyoma	1 (2%)
Hypertension	1 (2%)
Diabetes mellitus	0
Haematological disease	0
Pregnancy-related	
Gravidity	2.3±1.52; 2 (1-7)
Parity	0.61±0.79; 0 (0-3)
Weeks of gestation (weeks)	34±9; 37 (6-44)
Antenatal care in PYNEH (booked case)	36 (72%)
Mode of delivery	
Normal vaginal delivery	9 (18%)
Instrument-assisted	3 (6%)
Elective caesarean section	6 (12%)
Emergency caesarean section	32 (64%)
Time of admission	
Antepartum	11 (22%)
Postpartum	39 (78%)
Mode of admission	
Elective (booked before admission to ICU)	6 (12%)
Emergency	44 (88%)

* PYNEH denotes Pamela Youde Nethersole Eastern Hospital, and ICU intensive care unit
† Data are shown as No. (%), mean±standard deviation, or median (interquartile range)

as all other conditions that were not specifically pregnancy-related.

For each patient, data pertaining to ICU interventions (mechanical ventilation, haemodialysis, use of central or arterial lines, blood products/transfusions, operations, radiological and echocardiographic examinations) were retrieved. In addition, ICU length of stay, hospital length of stay, and the outcomes of all the mothers and infants (including numbers of deaths) were recorded and analysed.

For maternal outcomes, maternal mortality ratio was calculated; maternal death being defined as death while pregnant or within 42 days after termination of pregnancy.[13] Maternal mortality ratio was defined as the number of maternal deaths in a population divided by the number of live births during that time period. For neonatal outcome, the perinatal mortality rate was used, and defined as stillbirths and early neonatal deaths (early neonatal death refers to death from delivery till 6 days 23 hours 59 minutes).

To assess the long-term outcomes, questionnaires containing the validated Chinese version[14] of the Short Form–36 (SF-36[15]) Health Survey were sent to individual patients by mail. Telephone interviews were undertaken for patients who did not return the questionnaire. The SF-36 has been used in many clinical trials as an indicator of quality of care and effectiveness of health services. The scores of each item were summated and transformed into a scale score, which has a standardised range from 0 to 100; higher scores signifying better quality of life. The results thus obtained were compared with the normative values of the SF-36 Health Survey of the Chinese adult population in Hong Kong.[16]

Data analysis

Results were expressed as number and percentage, mean ± standard deviation (SD), and median (interquartile range) where appropriate. Comparisons of the characteristics of obstetric and non-obstetric patients were performed using the Student's *t* test. A P value of less than 0.05 was considered statistically significant. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, Windows version 12, Chicago [IL], US).

Results

A total of 50 obstetric patients were admitted during the study period, which represented 0.65% of total ICU admissions (50/7692) and 0.13% of all deliveries (50/37 505) during the 10-year period. Most of our patients were Chinese (94%); one was Indonesian, one a Filipino, and one an Indian. Four were mainland China visitors, none of whom had received antenatal care services in our hospital before admission. The median ICU stay was 2 days, while the median length of stay in hospital was 10 days.

The baseline characteristics of the 50 patients are shown in Table 2. The mean age of our patients was 31 (SD, 6) years. Nine patients were of advanced maternal age (≥35 years). The majority (86%) of these patients enjoyed good past health. The mean gestational age was 34 (SD, 9; range, 6-44) weeks. Six (12%) patients were admitted with a gestational age of less than 24 weeks. The most common mode of delivery was emergency caesarean section (n=32, 64%).

Most of the patients (n=39, 78%) were admitted in the postpartum period, the majority (n=35, 70%) for obstetric reasons, of which postpartum haemorrhage (n=19) was the most common. Table 3 summarises the diagnoses for ICU admission.

The most common underlying cause of postpartum haemorrhage was placenta

praevia (n=10), followed by uterine atony (n=7), intraperitoneal bleeding (n=1), retention of placenta (n=1), and uterine inversion (n=1). Hysterectomies were carried out in seven patients deemed to have severe postpartum haemorrhage. Thirteen patients underwent arterial embolisation, but in five of them bleeding was not controlled. Two of the latter had hysterectomies, two received recombinant factor VIIa (rFVIIa) [NovoSeven; Novo Nordisk, Bagsvaerd, Denmark] after arterial embolisation. One patient with uncontrolled haemorrhage received both modalities of treatment. The dosage of rFVIIa for the each patient was 7.2 mg (about 100 μg/kg for an estimated body weight of 70 kg). In these 13 patients, the per-patient mean estimated blood loss was 5.2 L and a mean of 13.7 units of packed cells was transfused.

Pregnancy-related hypertensive disorders were the second commonest obstetric cause of admission (n=7, 14%); three of the patients had severe pre-eclampsia, two had eclampsia, and two of them had associated haemolysis, elevated liver enzymes, and low platelet counts (also known as the HELLP syndrome). Three of these seven patients were nulliparous (43%). In all these patients, blood pressure control improved after delivery of the infant and therapy with anti-hypertensive drugs. One patient who was admitted for severe eclampsia suffered an intracranial haemorrhage and died the day after admission.

Among the 15 patients admitted for non-obstetric disorders, sepsis was the main reason (chest infections, followed by urinary tract infections due to *Proteus* species [n=1] and *Escherichia coli* [n=2]). Two of the patients admitted for urinary tract infections developed septic shock and received inotropic support. Three of the patients were admitted to the ICU due to neurological diseases and included one with viral encephalitis, one with *Streptococcus pneumoniae* meningitis, and one with an intracranial haemorrhage. The first two patients did well on medical treatment, but the one with an intracranial haemorrhage died 2 days after admission.

Table 4 is a comparison of obstetric and non-obstetric patients. Patients admitted due to obstetric causes were significantly older (33 vs 27 years, P<0.05), had higher parity (0.8 vs 0.2, P<0.05), and were more likely to receive mechanical ventilatory support (23 vs 6, P<0.05). The length of stay in the ICU was similar in both groups (median, 2 days). However, patients in the non-obstetric group had longer hospital stay than the obstetric group (median, 12 vs 10 days). By contrast, the APACHE II, SAPS II and SOFA scores were higher in the obstetric patients, though the differences were not statistically significant.

Arterial line insertion was the most common intervention (n=33, 66%), followed by mechanical ventilation (n=29, 58%). The mean duration of mechanical ventilation was 1.2 days (SD, 1.7 days), and no ventilator-associated complication was encountered. One patient admitted due to HELLP developed acute renal failure and received renal dialysis support for 4 days after delivery (continuous venovenous haemofiltration). Her renal function recovered and she was discharged from ICU on day 13. Dialysis was not undertaken after discharge from the ICU. Table 5 shows the interventions undertaken in ICU.

There were three (6%) maternal deaths in the course of these 37 505 deliveries in the study period, which amounts to 8 deaths per 100 000 births. Two of the deaths were in visitors from China, both of whom did not have antenatal care in our hospital.

Among the 46 viable pregnancies, there were three (6%) stillbirths and there was one (2%) neonatal death. The perinatal mortality rate was therefore 8%. The cause of the neonatal death was not known as

TABLE 3. Diagnosis for intensive care unit admission

Diagnosis	No. of patients
Obstetric (n=35)	
Postpartum haemorrhage	19 (38%)
Pregnancy-induced hypertension	
Eclampsia	2 (4%)
Severe pre-eclampsia	3 (6%)
HELLP* syndrome	2 (4%)
Amniotic fluid embolism	3 (6%)
Ruptured ectopic pregnancy	2 (4%)
Peripartum cardiomyopathy	1 (2%)
Antepartum haemorrhage	1 (2%)
Sepsis-related	
Septic abortion	1 (2%)
Retained placenta with shock	1 (2%)
Non-obstetric (n=15)	
Sepsis	
Urinary tract infection	3 (6%)
Chest infection	4 (8%)
Cardiac-related	
Chronic rheumatic heart disease	1 (2%)
Primary pulmonary hypertension	1 (2%)
Central nervous system–related	
Viral encephalitis	1 (2%)
Meningitis	1 (2%)
Intracranial haemorrhage	1 (2%)
Trauma	
Road traffic accident	1 (2%)
Thrombocytopenia for postoperative monitoring	2 (4%)

* HELLP denotes haemolysis, elevated liver enzymes and low platelet count

TABLE 4. Comparison of obstetric and non-obstetric groups*

	Mean±standard deviation, or No. (%)		P value
	Obstetric (n=35)	Non-obstetric (n=15)	
Age (years)	33±5	27±5	<0.05
Gestational age (weeks)	33±9	35±7	0.46
Gravidity	2.5±1.6	1.9±1.4	0.21
	2†	1†	
Parity	0.8±0.8	0.2±0.6	<0.05
	1†	1†	
Mode of delivery			-
Normal vaginal delivery	7 (20%)	2 (13%)	
Elective caesarean section	5 (15%)	1 (6%)	
Emergency caesarean section	20 (57%)	12 (80%)	
Mechanical ventilation (yes)	23 (67%)	6 (38%)	<0.05
Length of stay (days)			
ICU	2†	2†	0.46
Hospital	10†	12†	<0.05
APACHE II score	16±9	12±9	0.20
SAPS II‡	28±15	26±16	0.58
SOFA score§	3.7±2.1	2.9±3	0.30

* ICU denotes intensive care unit, APACHE Acute Physiology and Chronic Health Evaluation, SAPS Simplified Acute Physiology Score, and SOFA Sepsis-related Organ Failure Assessment

† Median value

‡ Worse parameter within 24 hours after admission

§ Based on results 24 hours after admission to ICU

TABLE 5. Interventions undertaken in obstetric patients admitted to intensive care unit

Intervention*	No. of patients
Arterial line insertion	33 (66%)
Mechanical ventilation (total)	29 (58%)
Invasive mechanical ventilation	26 (52%)
Non-invasive mechanical ventilation	3 (6%)
Central venous catheter	26 (52%)
Radiological intervention	
Arterial embolisation	13 (26%)
Radiological imaging	
Ultrasound abdomen	7 (14%)
CT brain	6 (12%)
MRI brain	1 (2%)
CT thorax	3 (6%)
CT abdomen	1 (2%)
Angiogram	13 (26%)
Inotropic support	8 (16%)
Echocardiogram	8 (16%)
Magnesium sulphate infusion	4 (8%)
Renal dialysis	1 (2%)

* CT denotes computed tomography, and MRI magnetic resonance imaging

TABLE 6. Comparison of the Short Form–36 Scale scores between our patients and the Hong Kong (HK) female population

Domain	Mean (standard deviation)	HK female population (18-40 years old)	P value
Physical functioning	77 (21)	95	<0.05
Role limitation due to physical problem	68 (46)	85	0.121
Bodily pain	64 (25)	85	<0.05
General health	53 (20)	57	0.447
Vitality	53 (21)	59	0.204
Social functioning	77 (25)	91	<0.05
Role limitation due to emotional problem	67 (41)	68	0.881
Mental health	67 (19)	72	0.244

the infant was born at home and died before arrival, whilst two cases of stillbirth were related to severe maternal pre-eclampsia and eclampsia and the cause of intrauterine death was unknown.

For HRQOL assessment, questionnaires were sent to the 47 surviving patients and a total of 25 (response rate, 53%) were returned by mail. The mean time to completion of the questionnaires following discharge from the ICU was 2 years 7 months. Table 6 is a comparison of the SF-36 Scale scores of our patients and normative values for Hong Kong females (aged 18-40 years). In this study, all eight domains of the SF-36 Scale scores were lower than the norms of the control group; in three of the domains (physical functioning, bodily pain, and social functioning), the scores were significantly lower than those in the Hong Kong norms. The greatest difference was in the bodily pain, for which the mean score was 64 in our study group compared to 85 in the Hong Kong norms.

Discussion

Critically ill obstetric patients accounted for a small proportion of our ICU admission, and the corresponding crude mortality rate was low. The most common cause of admission was postpartum haemorrhage, for which angiography with arterial embolisation with medical treatment controlled the bleeding adequately in most of the patients. Patients admitted for obstetric causes were older, had higher parity, and were more likely to receive mechanical ventilatory support than those admitted for non-obstetric causes. In these patients, the quality of life was lower than in the normal Hong Kong population of the same gender and age.

The mortality rate of our patients admitted to the ICU was 6%, which was similar to that reported in Hong Kong by Tang et al[17] in 1997. In developed countries, like England,[18] Canada,[19] and the United States,[20] the mortality rate in critically ill obstetric patients was within the range of 0 to 20%, suggesting that our results were comparable, whereas studies from China have reported rates of 15 to 20%.[21,22] In our cohort, the perinatal mortality was 8%, which was lower than the rate (11-35%) reported in similar studies from developed and developing countries.[17,19,23-25]

Postpartum haemorrhage was the most common cause (38%) of ICU admission in this series of case, as in other series reporting frequencies ranging from 16 to 53%,[1,3,17,19,23,25] and was also the commonest cause of admission encountered in studies from China.[21,22,26] Most of the postpartum haemorrhage could be managed conservatively. In severe cases, however, arterial embolisation and hysterectomy may be required. Before the advent of embolisation, hysterectomy used to be the mainstay treatment where deemed necessary. In a local study over 10 years ago,[17] 85% of patients with severe postpartum haemorrhage underwent emergency hysterectomy. In the present study, most of the patients with postpartum haemorrhage (n=13, 65%) were evidently controlled by arterial embolisation; only 35% (n=7) underwent hysterectomy. Three patients received rFVIIa to control bleeding. This drug was developed in 1999 for the treatment of bleeding episodes in haemophilia A or B, patients exhibiting inhibitors to factors VIII or IX, congenital factor VII deficiency, or acquired haemophilia.[27] However, in patients with obstetric and/or gynaecological haemorrhage, such use is still 'off-label'. The usual dosage of rFVIIa varied from 10 to 170 μg/kg. Franchini et al[28] recommended a bolus dose of 60 to 90 μg/kg, and a repeated injection within 30 minutes if there was no clinical improvement. In our study, the dosage of rFVIIa used was about 100 μg/kg. Complications including arterial thrombosis (resulting in myocardial infarction and cerebrovascular disorder) and venous thrombosis (pulmonary embolism) have been reported. Only three patients received this form of treatment, all of whom appeared to respond promptly without complications.

Pregnancy-related hypertension (n=7, 14%) was the second most common obstetric cause of admission in this series. Compared to other similar overseas series reporting a frequency of 14 to 40%,[1,3,17,18,23,24] our admission rate for this indication was considerably lower. In some Chinese studies,[21,26] the corresponding admission rate was around 30%. Our result was similar to that of Tang et al[17] reporting a figure of 14% in 1997. The low incidence could be because in our hospital, most pregnancy-related hypertensive disorders were managed in the labour ward instead of the ICU. Besides, maternal ethnicity is known to be related to the expression of pre-eclampsia. For example, African Americans have more pre-eclampsia than other racial groups.[29-31] Among Asian Americans and Pacific Islanders, Filipino women are reported to have the highest risk of gestational hypertension/pre-eclampsia,[32] in whom the point prevalence appears to be about 6%, compared to 2% in Chinese Americans. Most of our patients being Chinese might therefore explain our findings.

Three (6%) of our patient cohort were diagnosed to have amniotic fluid embolism (AFE), which was more frequent than rates of 0.1 to 2.2% reported in other recent studies.[2,17,20] Amniotic fluid embolism is a rare syndrome, associated with a high mortality (18[33]-33%[2,11]); a Chinese study[34] encountered a rate of nearly 50%. No patient died from AFE in our series. According to the United Kingdom Amniotic Fluid Embolism Register,[11] mortality due to AFE was much lower now than in the past, possibly due to early diagnosis and prompt treatment,[35] increasing awareness of the disorder and improved intensive monitoring and care. In our series, the low mortality may be because most patients with this condition underwent emergency caesarean section immediately if there was any clinical deterioration, and postoperatively they were invariably monitored in the ICU.

Sepsis is one of the most common non-obstetric causes of admission into ICUs. In our series, seven (14%) of the patients were admitted due to sepsis, which was similar to other series reporting values of 3%[19] to 7%.[19,25] Urinary tract infection is relatively common in pregnant women, who are particularly prone to acute pyelonephritis. Management of sepsis during pregnancy is similar to that in non-obstetric patients, attention being directed to adequate and prompt resuscitation of the mother and foetus. Close foetal monitoring of this condition is also important, for example, by cardiotocography.[36]

In this series, three patients were admitted due to neurological disorders. In 1997, To and Cheung[37] reported various neurological conditions in the Hong Kong obstetric population, among whom cerebrovascular disorder was the fifth most common neurological condition encountered in two local hospitals. In their experience, epilepsy, eclampsia, facial nerve palsy, and pituitary tumours occurred more frequently in that order. In patients with neurological disorders, the mortality ranged from 14 to 71%.[2,37] In a study of pregnancy and the risk of stroke,[38] the adjusted relative risk of intracerebral haemorrhage was 2.5 (95% confidence interval [CI], 1-6) during pregnancy and 28 (95% CI, 2-61) in the postpartum period. The overall adjusted relative risk of stroke during or within 6 weeks of pregnancy was 2.4 for having either an ischaemic or haemorrhagic

stroke. In our patients, no specific risk factor could be identified.

A total of 29 (58%) of our patients received invasive mechanical ventilation, which was similar to the rates of 19 to 60% reported from elsewhere.[3,17,23-25,39] The indications and duration of ventilation detailed in these studies were also similar to ours. Another common intervention was arterial embolisation, which is recommended for the management of severe postpartum haemorrhage by the Society of Obstetricians and Gynaecologists of Canada. Common complications of this procedure include: fever, haematoma at the site of puncture, contrast-related side-effects, neurological effects and ischaemia associated with arterial puncture. Long-term complications (foetal growth restriction in the next pregnancy and uterine necrosis) have also been reported.[40,41] In nine patients who underwent arterial embolisation for primary postpartum haemorrhage, Tsang et al[42] reported no serious complication after the procedures, nor was there any major complication in the 13 patients subjected to this procedure in our series.

For HRQOL, all the eight domains of the SF-36 Scale scores in our patients yielded lower mean scores than the norms for Hong Kong females of a similar age. It is difficult to determine whether the low scores were directly related to the obstetric illness that had led to their ICU admissions. However, a case-control study[43] about the postnatal morbidity after severe obstetric morbidity (significant haemorrhage and pre-eclampsia) found that such women continued to have negative consequences across a range of SF-36 domains. It is therefore important to continue follow-up and provide support to this group of patients, as ICU admission or hospitalisation may have potential physical and psychological impacts that affect quality of life.

That this was a retrospective study in which the diagnoses could only be based on information available from the medical records, was one of its limitations. Besides, this was a single-centre study and the results may not be generalised to other centres in Hong Kong that receive patients of other characteristics. For long-term outcome, we only assessed the HRQOL in this study. Many other longer-term clinical outcomes, eg Sheehan syndrome (related to significant postpartum haemorrhage), were not assessed. Besides, questionnaires for the HRQOL study were sent at different durations after discharge from ICU, with only a fair response rate (53%); this could have contributed to variability of the results.

Conclusion

This study demonstrated the characteristics of the critically ill obstetric patients admitted to our ICU in a 10-year period from 1998 to 2007. The most common causes were postpartum haemorrhage and pregnancy-related hypertension. Maternal mortality ratio was low. The findings of the present study reinforce the statement by the WHO that "There is a story behind every maternal death or life-threatening complication. Understanding the lessons to be learnt can help to avoid such outcomes".[6] Low HRQOL was detected in our patient cohort. Follow-up and support for this group of patients appears worthwhile.

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