

Prevention of maternal death: a perspective

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Although the maternal mortality rate in Hong Kong remains low over the past 43 years, there were five reported maternal deaths in 2021 to 2023. In a cross-sectional study on maternal death events in Hong Kong from 2000 to 2019, the leading causes of direct maternal death were suicide, hypertensive disorders, and obstetric haemorrhage, followed by amniotic fluid embolism, pregnancy-related infection, pulmonary embolism, and cardiac diseases, whereas the leading causes of indirect maternal deaths were stroke and cancer, followed by infection (including hepatitis B virus) and cardiac diseases.

Measures to improve maternal safety include evidence-based safety bundles, team communication and training, integrated multidisciplinary care for high-risk patients, risk-stratified levels of maternal care, and improvements in communication between providers and patients about early warning signs. A review of cases of severe maternal morbidity or near-missed cases may help prevent maternal mortality. The Hospital Authority has set up special maternity care units for monitoring of women with high-risk obstetric conditions by a multidisciplinary team of obstetricians, anaesthetists, and specialised midwives with critical care training. As most unintentional maternal deaths occurred between 6 weeks and 1 year after delivery, there is a need to extend postpartum care beyond the traditional 6-week postpartum period, especially for women with multiple medical conditions, mental health issues, or substance use disorders. Obstetricians should be aware of the causes of and preventive measures for maternal death. Every effort should be made to prevent maternal death.

Keywords: Maternal death; Maternal mortality; Obstetrics

Introduction

Maternal death is devastating for women, their families, and healthcare providers. The World Health Organization calls for urgent efforts to end preventable maternal deaths everywhere¹. Although there are no effective interventions to prevent maternal death in some cases, there are opportunities for effective interventions in other cases².

In Hong Kong, the maternal mortality rate (MMR) remains low over the past 43 years^{3,4}. There were no maternal deaths in 2013, 2016, 2019, and 2020, but there were five reported maternal deaths in 2021 to 2023³. The aim of this paper is to review the leading causes of and the current preventive measures for maternal death in Hong Kong.

Trend and causes of maternal mortality in Hong Kong

Maternal mortality is defined as the death of a woman during pregnancy or within 42 days of the termination of the pregnancy from any cause related to or aggravated by the pregnancy or its management but not from accidental causes⁴. The MMR is an important indicator of the quality of a health system. Over the past 43 years, the MMR per

100 000 live births in Hong Kong was <12, similar to that in Australia, Japan, Singapore, New Zealand, and Korea^{3,5,6}. In recent 20 years, the MMR was <5, similar to that in Canada, Denmark, Greece, Sweden, and Switzerland⁷. The low MMR is multifactorial and related to the provision of good obstetric, medical, and surgical care, as well as good health conditions of pregnant women^{6,8}. Hong Kong has an efficient transportation network, a universal low-cost healthcare system, free comprehensive high-quality antenatal and intrapartum care and emergency obstetric services^{9,10}.

Although there were no maternal deaths in 2019 and 2020, there were three, one, and one reported maternal deaths in 2021, 2022, and 2023, respectively³. Similarly, global maternal deaths have ceased to decline or have increased since 2015^{11,12}. Such a surge in maternal mortality in high-income countries could be due to a delay in childbearing, which results in a larger proportion of pregnant women who were of advanced maternal age, used

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assisted reproductive techniques, or had complex medical conditions^{11,12}.

In a cross-sectional study on maternal death events from 2000 to 2019 in Hong Kong, the leading direct causes were suicide, hypertensive disorders, and obstetric haemorrhage, followed by amniotic fluid embolism, pregnancy-related infection, pulmonary embolism, and cardiac diseases, whereas the leading indirect causes were stroke and cancer, followed by infection (including hepatitis B) and cardiac diseases⁹. Deaths related to abortion or ectopic pregnancy have become uncommon^{9,10}.

General preventive measures

Measures to improve maternal safety include evidence-based safety bundles, team communication and training, integrated multidisciplinary care for high-risk patients, risk-stratified levels of maternal care, and improvements in communication between providers and patients about early warning signs⁸. Safety bundles for obstetric haemorrhage, severe hypertension in pregnancy, maternal sepsis, and peripartum venous thromboembolism have been developed^{13,14}.

The use of maternal early warning signs can facilitate communication between bedside nurses and clinicians. Early detection of abnormal vital signs enables prompt evaluation and treatment to prevent morbidity or mortality¹⁵. Although the same observation chart is used to monitor vital signs in both pregnancy and postpartum periods, maternal vital signs (such as blood pressure and heart rate) change after delivery¹⁶. For example, the 97th centile of women's temperature was slightly higher postpartum than during pregnancy (37.8°C vs 37.5°C), although there was no clinical significance.

Before being discharged home, patients can be educated about danger signs for prompt recognition of symptoms and medical evaluation¹⁵, for example, home monitoring of blood pressure.

Reviewing cases of severe maternal morbidity may help prevent maternal mortality¹⁷. Severe maternal morbidity is defined as an index of 21 indicators of life-threatening events including blood transfusion, hysterectomy, heart failure, eclampsia, respiratory distress, and sepsis¹⁸. Its predictors are pre-pregnancy body mass index, maternal age, gestational age at delivery, mode of delivery, chorioamnionitis, and maternal diagnosis of cardiac disease, pre-eclampsia, and mental health condition¹⁹.

In Hong Kong, the maternal near miss (or severe maternal morbidity) ratio in 2019 was 5.51 per 1000 livebirths²⁰. The common causes of maternal near miss were postpartum haemorrhage (PPH) and severe complications of abortion or early pregnancy. Common organ dysfunctions were coagulation/haematological dysfunction, cardiovascular dysfunction, and uterine dysfunction. Early identification, close monitoring, and early intervention can prevent maternal mortality²⁰. Since 2018, the Hospital Authority has set up special maternity care units for monitoring of women with high-risk obstetric conditions by a multidisciplinary team of obstetricians, anaesthetists, and specialised midwives with critical care training²⁰.

As most unintentional maternal deaths occurred between 6 weeks and 1 year after delivery, there is a need to extend postpartum care beyond the traditional 6-week postpartum period, especially for women with multiple medical conditions, mental health issues, or substance use disorders²¹.

Preventive measures for specific disorders

Successful implementation of hospital-based bundles can reduce severe maternal morbidity from obstetric haemorrhage by 20.8%²². As delivery by Caesarean section increases the risk of haemorrhage, steps should be taken to reduce the number of unnecessary Caesarean sections²³. Uterine atony is the most common cause of PPH. Risk factors of uterine atony include prior PPH of any aetiology, placenta previa, placental abruption, uterine rupture, multiple gestations, and prolonged labour. The Royal College of Obstetricians and Gynaecologists and the International Federation of Gynaecology and Obstetrics published guidelines on the management of PPH in 2016 and 2022, respectively^{24,25}. The visual estimation of peripartum blood loss is inaccurate; clinical signs and symptoms of hypovolaemia should be included in the assessment of PPH²⁴. Rarely, PPH can be occult (without heavy vaginal bleeding) in cases of haemoperitoneum, paravaginal haematoma, or rectus sheath haematoma. Early use of intravenous tranexamic acid, in addition to oxytocin, should be considered as soon as PPH is diagnosed^{24,25}. A combination of pharmacological, mechanical, and surgical methods should be prepared to stop the bleeding according to the causative factor. Conservative measures should be tried first. If they fail, more invasive procedures should be performed promptly before the development of coagulation problems and organ damage. Massive transfusion protocols with early and aggressive transfusion of red blood cells,

fresh frozen plasma, platelets, and cryoprecipitate to correct coagulopathy, as well as laboratory and point-of-care testing to assess coagulopathy are useful for managing major PPH^{24,25}.

Screening for pre-eclampsia should be provided to pregnant women in early pregnancy. Using a combination of clinical risk markers, uterine artery pulsatility index, and placental growth factor at 11 to 14 weeks of gestation is more predictive than using clinical risk factors with or without the uterine artery pulsatility index^{26,27}. For women at increased risk of pre-eclampsia, low-dose aspirin prophylaxis should be commenced before 16 weeks of gestation and until 36 weeks of gestation²⁷. When pregnant women develop hypertension with a blood pressure $\geq 140/90$ mmHg, antihypertensive therapy is recommended, particularly urgently for pregnant or postpartum women with blood pressure $\geq 160/110$ mmHg. When pregnant women develop severe hypertension or pre-eclampsia with one or more maternal adverse conditions, inpatient care is required. Magnesium sulphate is the recommended treatment and prophylaxis for eclampsia. Timed delivery should be considered in women with pre-eclampsia from 36 weeks of gestation²⁷.

Risk factors for suicide include a history of psychiatric disorders, psychopharmacotherapy during pregnancy, and intimate partner violence²⁸. It is important to screen pregnant women during the antenatal period and provide at-risk women interdisciplinary perinatal management and psychobehavioural interventions²⁹. Screening pregnant women for drug abuse is a challenge because they are complicit in it. Screening for postnatal depression is needed³⁰. The Department of Health and the Hospital Authority have implemented the Comprehensive Child Development Service programme. One of its objectives is to identify and manage mothers with postnatal depression. Postpartum psychosis is related to maternal death from suicide. Personal and family histories of bipolar disorders are a risk factor for postpartum psychosis³¹. Frequent follow-up of women with mental health disorders within 1 year of delivery may facilitate prompt recognition of those at risk.

Amniotic fluid embolism is rare but associated with a high fatality rate. Although it cannot be prevented, early diagnosis and intervention may lead to better obstetric outcomes³². Its diagnosis is made clinically. It should be considered when there is sudden cardiorespiratory compromise in a pregnant woman, particularly if such events are followed by a coagulopathy and there are no other

probable causes. Known risk factors include Caesarean section, surgical vaginal delivery, placenta previa, placenta accreta, and abruption³². The immediate management is high-quality cardiopulmonary resuscitation. Ongoing management should involve a multidisciplinary team including anaesthesia, intensive care, and maternal-fetal medicine³².

Pregnancy-related infection can be prevented by evidence-based measures during labour or leaking. Early recognition and treatment of infection are important but challenging because the normal physiological changes of pregnancy may mask the signs and symptoms of sepsis³³. The diagnosis of sepsis should be considered in pregnant women with unexplained deteriorating status or end-organ damage in the presence of an infectious process, regardless of the presence of fever³³. Sepsis and septic shock are medical emergencies that require immediate treatment and resuscitation³³. When sepsis is suspected, empirical broad-spectrum antibiotics should be administered, ideally, within 1 hour. The deadliest pathogen is the invasive group A streptococcus³⁴. Half of the patients infected with this pathogen may rapidly deteriorate and develop septic shock within 2 hours of the first signs of infection³⁴. If the mean arterial pressure is <65 mmHg or the serum lactate level is >4 mmol/L, fluid resuscitation should be initiated rapidly³⁴. Cultures (blood, urine, respiratory, and others as indicated) and early source control should be obtained as soon as possible^{33,34}.

Thromboembolism has become the leading cause of death in Hong Kong¹⁰. Pulmonary embolism in pregnancy appears to be increasing, probably related to the increase in pregnancies conceived using artificial reproductive technology, advancing maternal age, obesity, and Caesarean deliveries, as well as improved detection^{10,35}. The American College of Obstetricians and Gynecologists provides guidelines on screening for thromboembolism risk, giving prophylaxis for those at increased risk of thrombotic events, and treating acute thrombotic events³⁶. The use of pneumatic compression devices in at-risk women can reduce maternal deaths from post-Caesarean pulmonary embolism⁸.

Cancer diagnosed during pregnancy is uncommon, but its incidence is likely to increase owing to an increasing childbearing age³⁷. Common cancer in pregnancy includes breast cancer, cervical cancer, malignant melanoma, and lymphoma³⁷. Gastric cancer during pregnancy is extremely rare, but its prognosis is poor. Pregnancy-associated breast cancers tend to have more aggressive features, but

overall survival remains similar³⁸. Early diagnosis and a multidisciplinary approach are required³⁸.

Pregnancy is a known risk factor for stroke, and haemorrhagic stroke or intracranial haemorrhage accounts for more than half of all strokes arising in both pregnancy and postpartum periods³⁹. Pre-existing risk factors associated with intracranial haemorrhage include increasing maternal age, chronic hypertension, new-onset pre-eclampsia, and eclampsia³⁹; it is important to control acute hypertension for prevention^{27,39}. In pregnant women with hypertensive disorder, ergometrine that has an adverse effect of hypertension should be avoided in the management of PPH. Maternal coagulation should be normalised by using intravenous tranexamic acid and fibrinogen replacement if needed³⁹. Timely diagnosis of intracranial haemorrhage by computed tomography or magnetic resonance imaging is vital for subsequent neurosurgical management³⁹.

Cardiovascular disease (CVD) can pre-exist or develop in both pregnancy and postpartum periods. Examples of CVD are coronary artery disease, pulmonary hypertension, valvular disease, cardiomyopathies, arrhythmias, aortopathies, and congenital heart disease. Women with established CVD should receive multidisciplinary assessment, counselling, and optimisation before conception, as well as close monitoring and medication management during both pregnancy and postpartum periods⁴⁰. A multidisciplinary team should include representatives from cardiology, anaesthesia, obstetrics, maternal-fetal medicine, and specialised nursing⁴⁰. If pregnant women develop adverse pregnancy outcomes including hypertensive disorders of pregnancy, fetal growth restriction, placental abruption, preterm delivery, or gestational diabetes mellitus, their short- and long-term risks of CVD events are increased because of decreased uterine artery blood flow, vascular endothelial dysfunction, inflammation, and vasospasm⁴⁰. So, pregnant women who develop CVD or adverse pregnancy outcomes should be counselled about their future CVD risk and the importance of sustainable healthy lifestyle modification and appropriate treatments to reduce subsequent CVD risk⁴¹.

Severe COVID-19 infection can cause maternal death in the second or third trimester⁴². Vaccination is the best way to reduce the risk of COVID-19 infection and its morbidity and mortality. Acute hepatitis B virus infection is uncommon with universal vaccination. Acute infection in pregnant women is associated with fewer typical clinical symptoms and delayed hepatitis B surface antigen loss and seroconversion, compared with acute infection in non-pregnant women⁴³. Close monitoring of liver biochemistries, prothrombin time, and changes in mental status are required. In rare cases, acute infections may progress to acute liver failure necessitating liver transplantation, which is associated with a high perinatal mortality rate⁴⁴.

Conclusion

Although the MMR in Hong Kong remains low, there were five reported maternal deaths in 2021 to 2023. Obstetricians should be aware of the causes of and preventive measures for maternal death. Every effort should be made to prevent maternal death.

Contributor

The author designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. The author had full access to the data, contributed to the study, approved the final version for publication, and takes responsibility for its accuracy and integrity.

Conflicts of interest

As an editor of the journal, KYL was not involved in the peer review process.

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Data availability

All data generated or analysed during the present study are available from the corresponding author upon reasonable request.

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