Discussion on Cases of Early and Late Maternal Death

The cause of death in each case was determined by coroner and postmortem report if it is available. If postmortem report is not available, final judgment would be made in a departmental case conference base on the clinical information and investigation results.

Haemorrhage was among the most common direct causes of early maternal death. Nevertheless, five out of six cases happened before 1985 and the last one was in 1993. In the recent two decades, there was a substantial improvement on management of obstetric haemorrhage. Measures adopted in our unit include establishment of clear departmental protocol on massive transfusion, which allows timely availability of blood products whenever they are necessary. Besides, various means are gradually introduced into our postpartum hemorrhage protocol for prevention and treatment of postpartum haemorrhage. Among these were prophylactic use of carbetocin and tranexamic acid in cases with high risk of postpartum haemorrhage, balloon tamponade, compression suture and interventional radiology support.¹

AFE was another leading direct cause of early maternal death in this review, but its dominance seemed to lessen in recent years. There were two cases of related death in
the 1980’s, three in the 1990’s, and one in the 2000’s. The authors were aware of at least one case surviving from clinically AFE in 2015. The reported mortality rates of AFE from previous studies are variable. More recent and those data from developed countries tend to have a lower fatality rate. For example, data from the United Kingdom revealed the maternal mortality rate was 86% in the 1980’s, while in the triennial report of 2000–2002, the mortality was 25%. This reflects its mortality rate is inversely proportional to the standard of medical care. Nevertheless, AFE remains unpredictable and unpreventable, and carries a high maternal mortality rate. Obstetricians need to have high index of suspicion and should manage it timely based on clinical diagnosis.

There was one case of cerebral anoxia due to difficult intubation and ventilation during caesarean section in 1979 resulting in maternal death. The patient had history of tuberculosis of spine and postmortem examination revealed rigid cervical spine with marked limitation of movement. Anticipation of any anaesthetic complication is an important part in reducing maternal morbidity and mortality. In our unit, we have set up a dedicated Obstetric-anaesthetic clinic for anesthetic assessment of high-risk Obstetric patients. Pregnant mothers with relevant medical conditions (e.g. myasthenia gravis, valvular heart diseases or morbid obesity) would be assessed by
senior anaesthetists with intrapartum anaesthetic plan generated well before their deliveries.

We found that, in numbers, deaths due to indirect causes surpassed those due to direct causes. Obstetricians must be alert to the non-obstetrics causes of maternal morbidity and mortality. Early multidisciplinary care is recommended for managing patients with medical or surgical problems. The case of undiagnosed phaeochromocytoma had good past health and uneventful pregnancy course until 36 weeks of gestation when she presented with sudden onset of vomiting, haemoptysis and shortness of breath. Pulse rate was all along 130-140 beats per minute since admission, while the blood pressure was around 140/90mmHg. She had desaturation and chest X-ray showed pulmonary edema. She also developed persistent high fever with negative infection workup. After joint assessment with cardiologist, the provisional diagnosis was peripartum cardiomyopathy. She required ventilator and inotrope support in intensive care unit following emergency Cesarean delivery. She developed cardiac arrest two days after delivery. Resuscitation was unsuccessful. Phaeochromocytoma was diagnosed only after post-mortem examination. On hindsight, it is too co-incidental to have peripartum cardiomyopathy and gestational hypertension coming hand-in-hand with an unexplained fever. Pheochromacytoma is well-known to be a “great
masquerader”, probably more so in pregnancy. Non-obstetric causes should take no less consideration in pregnancy.

The most common cause for late death was malignancy. One patient who died of carcinoma of stomach presented with symptoms that was common and easily overlooked. She had history of personality disorder and substance abuse induced psychosis. She had been repeatedly admitted to obstetric ward due to recurrent epigastric pain. Not until third trimester, was she found to have a vague mass over epigastrium. A giant stomach ulcer was identified by Magnetic Resonance Imaging. The diagnosis of adenocarcinoma of stomach was made after oesophago-gastroduodenoscopy. She was delivered by emergency caesarean section at 35 weeks due to fetal distress. Intra-operatively there were multiple peritoneal seedlings. Subsequent workup showed metastasis to bone and palliative radiotherapy was given. She finally succumbed five months after delivery. This case illustrated that concerns from patients, especially if persistent, should not be dismissed too easily as pregnancy-related, non-specific or non-organic.

**Limitation of the study**

Completeness of case ascertainment was hampered by retrospective design of the
study and lack of a central registry. It remained likely that some cases of late maternal death could not be recovered, especially before the availability of electronic patient record system in 1999. Identifying the exact cause of death was likely more reliable after 1986, as all maternal deaths were investigated by a coroner’s post mortem examination, unless the patients’ family refused referral to Coroner. Due to the rarity of maternal death, the small number of cases in our study only allowed a descriptive trend analysis. For more in-depth investigation, such as the differential mortality rates of various diseases under the influence of pregnancy, multicenter collaborative research is the way forward.

References
1. Varatharajan L, Chandraharan E, Sutton J, et al. Outcome of the management of massive postpartum hemorrhage using the algorithm "HEMOSTASIS". *Int J Gynaecol Obstet*. 2011;113(2):152-154. doi:10.1016/j.ijgo.2010.11.021
2. Clark SL. Amniotic fluid embolism. Clin Perinatal 1986; 13:801-11.
3. Vlies R. Amniotic fluid embolism. Why mothers die 2000–2002, Confidential Enquiry into Maternal and Child Health. 2004 London. Royal College of Obstetricians and Gynaecologists (pg. 96-101)
4. Reyes HA, Paquin JJ, Harris DM. Pheochromocytoma, "the Great Masquerader," Presenting as Severe Acute Decompensated Heart Failure in a Young Patient. *Case Rep Cardiol*. 2018;2018:8767801. Published 2018 Apr 29.
### Tables and Figures

| Type                        | Group number/ name                                                                 |
|-----------------------------|-----------------------------------------------------------------------------------|
| Maternal death: direct      | 1. Pregnancies with abortive outcome                                                |
|                             | 2. Hypertensive disorders in pregnancy, childbirth and the puerperium               |
|                             | 3. Obstetric Haemorrhage                                                           |
|                             | 4. Pregnancy-related infection                                                      |
|                             | 5. Other obstetric complications                                                   |
|                             | 6. Unanticipated complications of management                                       |
| Maternal death: indirect    | 7. Non-obstetric complications                                                     |
| indirect                    | - Cardiac disease (including pre-existing hypertension                              |
|                             | - Endocrine conditions                                                             |
|                             | - Gastrointestinal tract conditions                                                |
|                             | - Central nervous system conditions                                                |
|                             | - Respiratory conditions                                                           |
| Maternal death: | 8. Unknown/undetermined |
|----------------|------------------------|
| unspecified    |                        |

| Maternal death: | 9. Coincidental causes |
|----------------|------------------------|
|                | - Due to external causes |

### Table 2. Number of maternal death and maternal mortality ratios.

| Five Year Period | Early maternal death | Late maternal death | Comprehensive No. of live births (early death) | MMR | MMR (comprehensive maternal death) |
|------------------|-----------------------|---------------------|-----------------------------------------------|-----|----------------------------------|
| 1976-1980        | 12                    | 0                   | 12                                            | 25219 | 47.6               | 47.6               |
| 1981-1985        | 4                     | 0                   | 4                                            | 36590 | 10.9               | 10.9               |
| 1986-1990        | 8                     | 0                   | 8                                            | 36425 | 22.0               | 22.0               |
|       |       |       |       |       | 1991-1995 | 1996-2000 | 2001-2005 | 2006-2010 | 2011-2015 | Total |
|-------|-------|-------|-------|-------|-----------|-----------|-----------|-----------|-----------|-------|
|       |       |       |       |       | 9         | 3         | 6         | 4         | 1         | 47    |
|       |       |       |       |       | 0         | 0         | 8         | 2         | 3         | 13    |
|       |       |       |       |       | 9         | 3         | 14        | 6         | 4         | 60    |
|       |       |       |       |       | 22461     | 17649     | 19563     | 22962     | 24984     |        |
|       |       |       |       |       | 40.7      | 17.0      | 30.7      | 17.4      | 4.0       | 4.0   |
|       |       |       |       |       | 40.1      | 17.0      | 71.6      | 26.1      | 16.0      | 16.0  |

# Included one case of unknown cause (Group 8).

Table 3: Early maternal death (direct and indirect causes).

| Direct Causes | Causes of death* | Number of cases |
|--------------|-----------------|----------------|
|              | 1 Abortive outcome | 0              |
|              | 2 Hypertensive disorders | 1              |
|              | 3 Haemorrhage | 6              |
|              | 4 Pregnancy Sepsis | 2              |
|              | 5 Others | 11             |
|              | - Amniotic fluid embolism | 6              |
|              | - Pulmonary embolism | 2              |
|              | - Acute fatty liver of pregnancy | 2              |
|              | - Peripartum cardiomyopathy | 1              |
|   | Causes of death*                              | Number of cases |
|---|---------------------------------------------|-----------------|
| 1 | Cardiac disease                             | 4               |
| 2 | Endocrine conditions                        | 0               |
| 3 | Gastrointestinal tract conditions           | 2               |
| 4 | Central nervous system conditions           | 3               |
| 5 | Respiratory conditions                      | 2               |
| 6 | Genitourinary tract conditions              | 0               |
| 7 | Autoimmune disorders                        | 2               |
| 8 | Skeletal conditions                         | 0               |
| 9 | Psychiatric disorders                       | 0               |
| 10| Neoplasms                                   | 6               |
| 11| Infections not a direct result of pregnancy| 6               |
|   | **Total**                                   | **25**          |

*by ICD-10 classification.

Table 4: Late maternal death
|   | Category                          | Cases |
|---|-----------------------------------|-------|
| 1 | Malignancy                        | 6     |
| 2 | Autoimmune diseases               | 2     |
| 3 | Psychiatric diseases              | 1     |
| 4 | Substance abuse                   | 2     |
| 5 | Central nervous system conditions | 1     |
| 6 | Unknown                           | 1     |
|   | **Total**                         | **13**|

Supplementary Figure 1. Death by category over time.