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Research Article

Major Obstetric Hemorrhage: What Can We Learn from Severe Maternal Morbidity Case-Series Review?

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Abstract

Background: Major Obstetric Hemorrhage (MOH) is a leading cause of Severe Maternal Morbidity (SMM) world-wide, and around 50% of cases are potentially preventable.

Aim: To present in-depth descriptive evaluation of the clinical pathway of cases of MOH identified in a SMM review, to highlight clinical action points for improvement in care.

Method: A secondary analysis of the clinical pathway of women who were pregnant or within 42 days of pregnancy who were admitted to an intensive care unit or high dependency unit after suffering a major obstetric hemorrhage (defined as ≥2L blood loss) from 1st March 2011 - 31st August 2012 from four District Health Boards in New Zealand.

Results: Forty-three women with major obstetric hemorrhage were identified. Of 11 women with identifiable risk factors only 6 had a documented plan for active management of third stage and preparedness for prevention of postpartum hemorrhage. Drug management varied and resuscitation was often inadequate. Uterine atony was the commonest source of bleeding (40%). The most common intervention after drugs was intra-uterine balloon, of which 77% were successful. B-Lynch sutures and interventional radiology were less frequently used. Four women required hysterectomy.

Conclusion: This study highlights where improvements in clinical care and systems are needed, and gives recommendations to reduce the severity of morbidity for women suffering this severe obstetric event. These include recognition and documentation of risk factors, plan for active management of third stage, routine use of Modified Early Obstetric Warning charts, and adequate resuscitation.

Introduction

Major Obstetric Hemorrhage (MOH) is the leading cause of maternal mortality world-wide. In high income countries where mortality figures are relatively low, it is one of the commonest causes of Severe Maternal Morbidity (SMM) and the rates are increasing [1-3]. SMM is defined by the World Health Organization (WHO) as 'the near death of a woman who has survived a complication occurring during pregnancy or childbirth or within 42 days of the termination of pregnancy' [4]. SMM affects more than 1% of pregnant or recently delivered women and MOH accounts for up to half of these cases [5-8].

Obstetric hemorrhage is classifiable both with respect to timing of bleeding as well as volume of blood loss. It can occur antepartum when the bleeding occurs after viability but before delivery, intrapartum during labour, or postpartum after delivery. Major Obstetric Hemorrhage (MOH) is variously defined according to the degree of blood loss or acute transfusion requirements. The range of blood loss for MOH is >1.5L up to >2.5L. Different professional bodies use "more than 3" or "more than 4" unit's red blood cell transfusion as the definition of major obstetric hemorrhage [9-11]. Globally, up to 50% of cases of death and morbidity due to major obstetric hemorrhage are potentially preventable [12-14].

In line with international findings, a recent multidisciplinary external preventability review of SMM in New Zealand (NZ) found that almost 50% of cases due to major obstetric hemorrhage were potentially preventable and some degree of substandard care was identified in a further 30% of these cases [15]. The aim of this paper is to present an in-depth descriptive evaluation of the clinical pathway of cases of major obstetric hemorrhage identified in a preventability review of SMM in order to highlight areas of care where improvement could be made. The hope is to reduce the risk of women suffering severe maternal morbidity from MOH in New Zealand (NZ) [16,17].

Method

This is a secondary analysis of cases collected for a multidisciplinary preventability review of Severe Maternal Morbidity (SMM). The inclusion criteria were women who were pregnant or within 42 days of termination of pregnancy (by delivery or miscarriage or other), who were admitted to an Intensive Care Unit (ICU) or High Dependency Unit (HDU) in four NZ District

Health Boards (DHBs) between 1st March 2011 and 31st August 2012.The four DHB maternity departments were approached because they represented a cross section of the New Zealand population and all agreed to take part. They included three urban tertiary centres and one rural secondary centre with a combined total of 21,000 deliveries per annum – approximately one third of all annual deliveries in New Zealand. All 4 DHBs have primary care birthing units as part of their maternity system. 15 Cases for this secondary analysis were women who had suffered a major obstetric hemorrhage (defined as ≥2L blood loss).

In NZ, maternity services are publicly funded although women may choose to pay for a private obstetrician. A pregnant woman registers with a Lead Maternity Carer (LMC) provider. In 2013, 82% of women booked with a self-employed midwife, 5% with an obstetrician, 1% with a general practitioner (family physician) and 12% with public hospital teams [18]. If there are complications during pregnancy a LMC usually refers the patient to a hospital obstetric team for transfer of care according to national referral guidelines [19].

The detailed process of the NZ preventability review of SMM has been recently described [20]. Following preventability review by panels, cases with MOH were identified and extracted from the data base. The case notes were then reviewed by one of the authors, who were blinded to the preventability results, ethnicity and socioeconomic decile and who undertook detailed analysis of the clinical pathway of these women.

Ethnicity and socioeconomic deprivation index were matched for each SMM case from the Ministry of Health Information Services using the National Health Index (NHI) number – a unique identifier which links to centrally held ethnicity and allows linkage to area-based deprivation index information (NZ Dep index) [21]. The NZ Dep index gives socio-economic status ranging from decile 1 (least deprived) to decile 10 (most deprived) and is reported here in quintiles [22].

National ethical approval was obtained from the Multi-Regional Ethics Committee (MEC/11/EXP/035) and Protected Quality Assurance Status (PQAA) obtained from the Ministry of Health under the Health Practitioners Act 2003 gazetted in Sept 2011 (SR2011/305:3895). The study had local and Maori consultation approval by the ethics board of each DHB involved.

Results

Of the 43 women with major obstetric hemorrhage, 2 were related to ectopic pregnancy and 3 related to miscarriage (6, 16 and 18 week's gestation respectively). The socio-demographic characteristics of the 43 women are shown in Table 1. There were 16 caesarean sections (42%) of which 4 were elective and 12 were emergency procedures. Spontaneous vaginal delivery accounted for 17 (45%) and 5 women required instrumental vaginal delivery (13%). There were two twin deliveries: one set delivered by emergency caesarean section, the other set delivered vaginally.

Risk factors for Post-Partum Hemorrhage (PPH) were present in 11women (11/38 – 29%) and some had more than one risk factor. Six women had a history of previous PPH, 2 had had previous placenta praevia, 2 had previous history of retained placenta, 2 were grand-multiparous and 2 had twin pregnancies. Six women had a clearly documented plan for management to prevent PPH, both for active management of third stage of labour and emergency preparedness. Five women with risk factors for PPH did not have a plan for management. Three had previous PPH, one was para 7, two had twin pregnancies and one had previous placenta previa.

Estimated blood loss ranged from 2L to 10L with a median of 3L. In 10 (23%) women the blood loss was measured by weighing

Table 1: Socio-Demographic Characteristics.

Characteristic	n	%
Age Groups (years)		
Less than 20	6	16
20-29	13	34
30-39	13	34
40 and above	6	16
Ethnicity of mother		
NZ European	14	33
NZ Maori	9	21
Pacific people	9	21
Asian	10	23
Other	1	2
Smoker		
Yes	10	23
No	32	75
Not recorded	1	2
Parity		
Nulliparous	20	46
Multiparous (1-4)	21	49
Grand multiparous (>4)	2	5
Gestation at delivery		
<36 weeks	7	16
36 – 41 weeks	27	63
>41 weeks	4	9
<20 weeks (miscarriage)	3	7
Post ectopic	2	5
BMI kg/m²		
<30	20	47
30-34	7	16
35-39	6	14
>39	1	2
Not recorded	9	21
Deprivation index inquintiles- socio-economic status 1 = least deprived, 5 = most deprived (see method)[21]		
1	6	14
2	4	9
3	6	14
4	8	19
5	19	44

Table 2: Causes[¤] of major obstetric hemorrhage.

Timing	Source	Additional information	No.	No.	%
Pre-viable					
	Ectopic pregnancy		2	**2**	**5**
	Miscarriage with retained products	first trimester	1	**3**	**7**
		mid-trimester	2		
Antepartum					
	Abruption		2	**3**	**7**
	Other	IUD and DIC	1		
Intrapartum					
	Uterine rupture	previous LSCS, in labour	1	**2**	**5**
		vaginal delivery	1		
	Other	surgical trauma at caesarean section	4	**4**	**9**
Postpartum					
	Uterine atony	uterine atony alone	8	**17**	**40**
		uterine atony with tissue trauma	4		
		atony with retained tissue	5		
	Retained products of conception (Normal Placentation)	part of placenta remaining	2	**8**	**19**
		membranes only	2		
		whole placenta	4		
	Placenta previa		6	**8**	**19**
	Placenta percreta		2		
	Trauma to birth canal	spontaneous vaginal delivery	5	**10**	**23**
		forceps delivery	4		
		cervical trauma	1		
	Uterine inversion	instrumental delivery	1	**2**	**5**
		attempted manual removal of placenta	1		

[¤] May be more than one cause of bleeding so adds up to more than 100%.

swabs and/or measuring suction. Table 2 shows the source of major obstetric hemorrhage. Some women had more than one source of hemorrhage: uterine atony in 17/43 women (40%), trauma to the birth canal in 10/43 (23%), retained products of conception in 8/43 (19%), placenta praevia in 6/43 (14%) and a further two with placenta percreta (5%). Two women suffered a ruptured uterus.

The 3 women with miscarriage were all given a synthetic oxytocinbolus of 5 or 10 IU. (Syntocinon®, RotexMedica)The 2 mid-trimester miscarriages also had anoxytocin infusion. In addition, these 3 women received a variety of other ecbolics including misoprostol800mcg (Cytotec®, Pfizer) ergometrine 500mcg (Hospira) and carboprost 250mcg (Prostin®, Pfizer). One had tranexamic acid 100mg/ml (Cyklokapron® Pfizer), all received Intravenous (IV) antibiotics. The 2 women with ectopic pregnancies required crystalloid, colloid and Red Blood Cells (RBC).

The other 38 women had deliveries after 20 weeks of gestation. Of these 27/38 (71%) women had more than one IV cannula, and 25 (66%) had at least one 16G cannula. Arterial lines were placed in 23/38 women (61%) and 13/38 (34%) had central venous lines. The massive transfusion protocol (MTP) was activated for 17/38 women (40%). The median quantity of RBC transfused was 5 units, with a range of 2-20 units. Fourteen women had RBC alone, 29 had other blood products including fresh frozen plasma (FFP), cryoprecipitate and platelets. Eight women received all 4 blood products. The lowest recorded Haemoglobin (Hb) was 47g/L, with amedian of 72 g/L. Hb levels at discharge ranged from 82-126 g/L, with a mean of 98 g/L and median of 97 g/L. Coagulation studies were documented in 20, of whom 13 had a coagulopathy (International Normalised Ratio (INR)>1.2).

Modified Early Obstetric Warning System Charts (MEOWS) were used prior to the event in 12 women (32%) - 6 were acted on and 2 had the score properly calculated. There was no information about urine output and urinary catheters on the MEOWS. Documentation of oxygen supplementation was noted in 6 women.

Drug management included oxytocinbolus IV (5 IU) or oxytocinbolus IM (10 IU) given as first line management in 35/38 women with PPH. Management was not documented in 2 cases and one had placenta percreta proceeding directly to hysterectomy without any ecbolic. Oxytocin infusion was second line management in 25 of 35 (71%) with varying doses. Twenty-one women received Syntometrine® (ergometrine maleate 0.5mg plus synthetic oxytocin 5 IU in 1 ml, Alliance Pharmaceuticals Limited), as first line, 5 as

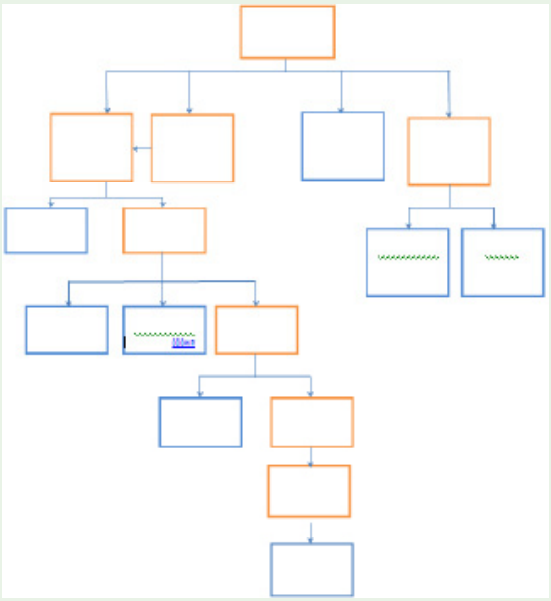

Figure 1: Interventions and outcomes of SMM cases with major obstetric hemorrhage (n=40).
*excludes 1 first trimester miscarriage and 2 ectopics.
**interventional radiology - insertion of balloon catheters into pelvic vessels under radiological control.
***known placenta percreta.

second line and 12 as third line management. Three women had a second ampoule of Syntometrine*. Three women had ergometrine alone. Misoprostol was administered to 18 women (47%) 3rd or 4th line with 14 women receiving 800 mcg initially. Twenty-eight women received carboprost as either 4th or 5th line (250 mcg IM at 15 min intervals to maximum of 2000 mcg). Ten women (26%) received tranexamic acid. The commonest dose was 1g IV, mostly late in the sequence of drugs.

Figure 1 shows the interventions and outcomes of those women who had a mid-trimester miscarriage or delivery after 20 weeks (n=40). After medical management with drugs, 22/40 (55%) had an intra-uterine balloon placed of which 17 (77%) were successful. Three women had B-Lynch sutures. Interventional radiology was effective in the 5 women who received this management. Four women required caesarean hysterectomy. Two women had planned caesarean hysterectomy for known placenta percreta and two women required emergency hysterectomy after other measures failed.

Discussion

The results of this study demonstrate variability in the management of 43 women who suffered major obstetric hemorrhage in New Zealand. The findings highlight several clinical areas which could be addressed to improve the care of women at risk of, or affected by major obstetric hemorrhage with a view to decreasing severe morbidity.

Although it is well recognized that most PPH cannot be predicted, there are identifiable risk factors for PPH.1, 3 Forty percent of women who had risk factors for PPH were not recognised as such and had no documented plans of management. Optimising antenatal haemoglobin by correcting iron deficiency anaemia and active management of third stage are known to be effective in decreasing the risk and morbidity of PPH [23,24]. Women with known placenta previa or placenta percreta were recognised as high risk and appropriate preparations were made.

Modified Early Obstetric Warning System Charts (MEOWS) were used prior to the event in only 12 women (32%) and only half of these were acted on (16% of all PPH) with scores rarely calculated. A MEOWS chart is most useful in the apparently normal situation where an emergency evolves otherwise unnoticed. Correct use of MEOWS charts has been shown to reduce the severity of maternal morbidity [25].

Estimation of blood loss is known to be very inaccurate and often underestimated. Accuracy can be improved by weighing swabs and/or measuring suction. This was carried out in only 10 women (23%) in this study. Just over half of women had vaginal deliveries and trauma to the birth canal was the source of bleeding in 21% of the total.

In this cohort, 9 (26%) women were managed with only one IV cannula and 2 of these were only 18G. This is inadequate for managing major obstetric hemorrhage. Massive Transfusion Protocols (MTP) was introduced in all of the 4 DHBs between 2009 and 2011, prior to the notification of these cases. Activation of MTP gives almost immediate access to blood products including red blood cells, FFP, cryoprecipitate and platelets. In this analysis 40% of these cases had the MTP activated and haematologists were consulted five times (12%).

Oxygen administration was documented in only 6 women other than those women who had a general anaesthetic, so 21 women had no documentation of oxygen administration during their resuscitation. Oxygen is often not documented in clinical notes as it is considered "routine". However, it is the authors' experience when observing educational scenarios, or attending real life emergencies that oxygen is often forgotten.

First line drug management was with IM or IV oxytocin in all cases, prophylactically at delivery or after recognition of PPH. Oxytocininfusion was second line management in 71% compared to 96% of women in the Scottish Confidential Audit of Severe Maternal Morbidity [16]. Oxytocininfusion regime should be standardised nationally. Misoprostol and carboprost were variously used for 3rd and 4th line management and the dose of misoprostol varied. Tranexamic Acid (TXA) has been found to be effective in non-obstetric surgery and in trauma to reduce blood loss and decrease the need for blood transfusion. There is concern that TXA may increase the risk of thrombosis and thromboembolic events in postpartum hemorrhage as these women are already at high risk of thrombotic events. The WOMAN trial is currently being conducted to examine the risks and benefits of TXA in postpartum hemorrhage [26]. Current WHO guidelines (2012) recommend the use of tranexamic acid when uterotonics have failed to stop bleeding or hemorrhage is thought to be due to trauma [23].

Emergency interventional radiology is not widely available in New Zealand tertiary hospitals due to system issues around staffing which accounts for its low use here. For the five women who needed interventional radiology, it was effective in avoiding hysterectomy. B-Lynch sutures were not often used, and their use in PPH may have been reduced by the successful use of intrauterine balloons and in

effect the lower need for laparotomy. When intrauterine balloons failed it is noted that there were inadequate filling volumes or no vaginal packing had been used.

The quickest way to assess Hb levels is for the theatre team to have immediate access to a blood gas machine. Sampling from an arterial line is the most accurate. Twenty-four women (56%) of those suffering major obstetric hemorrhage had an arterial line. As some women would have been cared for in a remote operating theatre in Delivery Suite, rather than as part of the main operating suite a blood gas machine may not have been available. In these situations, a point of care device can be used for an estimation of either haemoglobin level, or coagulation studies. Thromboelastography (TEG) is a quick way to measure coagulation status in the theatre without needing laboratory facilities. Activation of a Massive Transfusion Protocol (MTP) ensures coagulation products are provided in a predetermined ratio.

The New Zealand Ministry of Health introduced National Consensus Guidelines for the Treatment of Postpartum Hemorrhage in 2013, after the cases for this audit occurred [27]. A further audit of SMM cases caused by severe PPH after the release of the guidelines is necessary to assess whether their dissemination has been effective in improving the care of these women.

Although this study has the limitation of small numbers so the statistical findings are not generalizable, there are specific learning points which can be made.

Conclusion

This study highlights specific action points where improvements in clinical care and systems could be made to ensure prompt action leading to a reduction in secondary injury due to poor perfusion and coagulopathy.

1. Recognition and documentation of risk factors in pregnancy, and factors that arise during labour
2. Plan for active management of third stage
3. Recognition and intervention to decrease bleeding
   a. removal of retained placenta
   b. administration of ecbolics
   c. adequate suturing by a skilled clinician in an appropriate environment
4. Routine use of MEOWS for early recognition of hemorrhage
5. Accurate measurement of blood loss
6. Adequate resuscitation
   a. restoring blood volume
   b. administering blood products
7. Definitive management

All clinicians involved in maternity care should be mandated and funded to attend regular education sessions including skills, communication, teamwork and simulation of the management of major obstetric hemorrhage. This, together with the National Consensus Guidelines, should result in improved outcomes for all women suffering major obstetric hemorrhage.

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