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Why is post-partum haemorrhage more common in women with congenital heart disease?

Matthew Cauldwell [a,*], Kate Von Klemperer [b], Anselm Uebing [b], Lorna Swan [b], Philip J. Steer [a], Michael Gatzoulis [b], Mark R. Johnson [a]

[a] Academic Department of Obstetrics and Gynaecology, Imperial College London, Chelsea and Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK
[b] Adult Congenital Heart Centre, The National Heart and Lung Institute, Imperial College London, Royal Brompton Hospital, Sydney Street, London SW3 6NP, UK

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ABSTRACT

Objective: To identify the factors associated with an increased post-partum blood loss in women with congenital heart disease (CHD).
Methods: The study was a retrospective cohort study, which included 366 nulliparous women with CHD and a singleton pregnancy cared for in a single tertiary centre (Chelsea and Westminster Hospital) between 1994 and 2014. The women were classified into one of 12 different functional groups and univariate and multivariate regression analysis were used to identify factors associated with increased blood loss at delivery.
Results: The average volume of blood loss in women with CHD was twice that expected. Univariate analysis showed that White European women had the lowest blood loss. Women who had been on anticoagulants, had a forceps delivery, emergency Caesarean section or general anaesthesia lost more blood than those having a spontaneous vaginal birth under regional analgesia. Higher CARPREG scores were associated strongly with increased blood loss. Women with a Fontan circulation had the highest blood loss and the difference remained significant after correcting for other significant variables.
Conclusions: Women with CHD are at increased risk of PPH. We have identified several potentially modifiable risk factors that may be targeted to reduce this risk. In addition, women with a Fontan circulation were most prone to PPH, independent of other risk factors, suggesting the existence of lesion-specific abnormalities and the need for extra vigilance in this group of women at the time of birth.

1. Introduction

The majority of women with congenital heart disease now reach reproductive age and choose to embark on a pregnancy. While cardiac disease remains the leading cause of direct maternal death in developed countries, the actual number of deaths is relatively small [1]. This is particularly true in women with congenital heart disease (CHD), most of whom appear to have relatively uncomplicated pregnancies [2]. However, obstetric morbidity is high in women with CHD and the time at which most women are likely to encounter cardiac complications is in the third trimester and after delivery [3–5], with increased risks of preterm delivery, growth restriction, stillbirth and post-partum haemorrhage (PPH) [6–8].

Blood loss equal to or greater than 500 ml at vaginal delivery and equal to or greater than 1000 ml at Caesarean section is classified as a postpartum haemorrhage (PPH). Some blood loss is expected at delivery, but women with CHD are widely reported to experience greater than expected blood loss for reasons that are poorly understood [9–10]. Individual risk factors have been identified for normal women who have a PPH, but in women with CHD they have not been well studied [11–12]. With some conditions such as metallic heart valves, the rates of PPH are particularly high, exceeding 30% [13]. Increased blood loss at delivery is of particular concern in women with cardiac disease as large volume shifts can adversely impact cardiac function, potentially inducing hypotension earlier and causing more severe and greater compromise. Understanding which women with cardiac disease are at greatest risk of haemorrhage is important as it can give us an insight into the mechanisms involved and allow us to target therapy appropriately.

We therefore performed a retrospective analysis of the case notes of women with CHD to identify factors that are associated with increased post partum blood loss. We also investigated whether specific lesions or severity of heart disease were linked to a greater risk of PPH.

2. Methods

A retrospective study was carried out of 427 nulliparous women with CHD who had been managed by the Joint Obstetric Cardiac Service at Chelsea and Westminster and Royal Brompton Hospitals, from

* Corresponding author.
E-mail address: matthew.cauldwell@imperial.ac.uk (M. Cauldwell).

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January 1995 through December 2014. The exclusion criteria were failure to ascertain the blood loss at delivery because (i) the patient delivered at another hospital (n = 25), or (ii) because the original notes could not be found (n = 18), and further, we excluded any pregnancy prior to 18 weeks gestation (n = 4) and we also excluded multiple pregnancies (n = 10) and women identified as having signs of sepsis during their labour or at the point of delivery (n = 22) (maternal temperature > 37.8 degrees on two separate occasions, at least one hour apart, or positive blood or urine cultures).

This left a total of 366 pregnancies for analysis. Data were collected from a detailed case note review and from CMIS, the hospital computerised maternity database. The patient's underlying cardiac diagnosis was recorded from the case notes. CHD is heterogeneous and, to facilitate analysis, women were allocated to the single most functionally important diagnosis. The CARPREG [5] and the New York Heart Association (NHYA) scores [5] were calculated for each patient at the first antenatal visit. Twelve separate cardiac diagnostic groups were defined and patients were allocated to one of these groups by a cardiologist (KvK) (Table 1). To ensure that the diagnoses taken from case notes were correct, we crosschecked with clinic letters and the most recent echocardiogram reports prior to delivery. The corresponding CARPREG scores are also shown in Table 1. The baseline characteristics of the study population are shown in Table 2. Obstetric variables included in the analysis were induction of labour, gestation at delivery, length of second stage, mode of delivery, type of anaesthesia at delivery and birthweight (Table 3). We also included the use of cardiac medications, beta-blockers, aspirin and low molecular weight heparin (LMWH, Table 4). Blood loss was taken as the value that was recorded in the obstetric case notes or, if not recorded in the notes, then the amount documented in the CMIS database. Data were analysed using SPSS version 23. A p value of less than or equal to 0.05 was considered significant.

Table 1
Breakdown of cardiac lesions for all women with accompanying CARPREG scores.

Classification	N	CAREPREG 0	CARPREG 1	CARPREG 2
Left heart obstruction (LHO)	75	45	28	2
Repaired co-arctation	42			
Aortic stenosis	15			
Mitral stenosis	11			
Sub-aortic stenosis	6			
Left heart regurgitation (LHR)	42	40	2	0
Mitral regurgitation	28			
Aortic regurgitation	14			
Right heart obstruction (RHO)	19	17	2	0
Pulmonary stenosis	19			
Right heart regurgitation (RHR)	17	16	1	0
Pulmonary regurgitation	11			
Ebstein	4			
Tricuspid regurgitation	2			
Tetralogy of Fallot (TOF)	50	9	0	0
Tetralogy of Fallot	43			
Double outlet right ventricle	4			
TOF/pulmonary atresia/MACPAS	2			
Pulmonary hypertension (PHTN)	9	2	5	2
Eisenmengers	3			
Repaired VSD	3			
Idiopathic	1			
Primary lung disease	1			
TOF variant with MAPCAS	1			
Mechanical valve (MV)	11	5	4	2
Aortic valve	3			
Mitral valve	6			
Both aortic and mitral valve	2			
Marfan	28	28	0	0
Systemic ventricular dysfunction (SysVD)	44	17	22	5
Transposition great arteries— mustard repair	12			
Arterial switch	10			
Dilated cardiomyopathy	16			
Hypertrophic cardiomyopathy	6			
No residual lesion (NRL)	33	32	1	0
Repaired ASD	18			
Repaired VSD	15			
Left to right shunt (LRS)	30	29	1	0
Unrepaired ventricular septal defect	14			
Unrepaired atrial septal defect	14			
Patent ductus arteriosus	2			
Fontan	8	2	6	0

3. Results

The baseline characteristics of the 12 groups were broadly similar (Table 2). Univariate analysis (Pearson correlation coefficient) showed that the only demographic variable to correlate significantly with blood loss was the woman's racial origin, demonstrating that women who were White European had significantly less blood loss than women from other racial groups (p = 0.033).

Analysis of obstetric variables (Table 3) showed that the only significant difference between groups of CHD was mode of delivery, because women with Pulmonary Hypertension were all delivered by CS (6 electively and 3 as emergencies). In addition, they were delivered significantly earlier, at a mean gestation of 34.2 weeks followed by women with Fontan circulation (35.7 weeks), women with a mechanical valve (36.4 weeks) and women with systemic ventricular dysfunction (37.6 weeks). Spontaneous vaginal delivery was associated with the lowest mean blood loss 439 ml, (p = 0.001). The use of forceps and Emergency CS and General Anaesthesia (GA) were all associated with significantly higher blood loss 715 ml, 722 ml and 854 ml respectively (p = 0.042, p = 0.008, p = 0.002).

Fig. 1 shows the distribution of estimated blood loss at delivery, ranked by magnitude in relation to cardiac lesion. The only lesion to correlate significantly with increased EBL was Fontan circulation (p = 0.001).

Table 2
Demographics for whole cohort of patients arranged by cardiac lesion.

Underlying lesion	Total N	White European N	%	Asian N	%	Black African N	%	Mean age (years) + SD
LHO	75	58	77	4	5	11	15	30 (4.8)
LHR	42	32	76	7	17	3	7	33 (5.1)*
RHO	19	15	79	3	16	1	5	28 (6.3)
RHR	17	17	100	0	0	0	0	31 (4.8)
TOF	50	42	84	4	8	1	2	28 (5.8)*
PHTN	9	3	33	4	44	2	22	30(4.6)
MV	11	5	45	2	18	4	36	31 (8.6)
Marfan	28	25	89	1	4	2	7	31 (4.88)
SysVD	44	34	77	8	18	1	2	29 (5.4)
NRL	33	27	82	2	6	4	12	31 (6.6)
LRS	30	28	93	2	7	0	0	30 (5.8)
Fontan	8	6	75	2	25	0	0	32 (5.25)
Total	366	292		39		29		

Underlying lesion	Mean BMI + SD	Mean height (cm) + SD	Mean weight (kg) + SD
LHO	24 (4.07)	165 (7.02)	65 (12.3)
LHR	23(3.7)	165 (7.5)	63 (9.8)
RHO	27 (6.7)*	164 (7.0)	72 (17.25)*
RHR	23 (4.1)	164 (8.3)	61 (4.7)
TOF	24(4.8)	163 (6.63)	64 (11.7)
PHTN	24 (5.6)	156 (10.2)*	57 (7.9)
MV	27 (6.6)	165 (8.52)	72 (17.27)
Marfan	22(4.5)*	179 (8.3)*	71 (17.44)
SysVD	25(4.3)	162(7.0)	66 (13.1)
NRL	23 (4.4)	167 (8.4)	65 (14.4)
LRS	25(5.3)	164(7.1)	67 (17.9)
Fontan	24 (2.5)	164 (7.6)	64 (9.44)

Total.
* = p < 0.05.