Risk Factors for Predicting Blood Transfusion in Caesarean Section in Hong Kong: Is Type and Screen Necessary for All?

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Objective: Routine preoperative blood group typing and antibody screening (type and screen) is performed for all patients who undergo Caesarean delivery in our unit in preparation for blood transfusion. There are no objective local data to support such practice. This study aimed to examine the risk factors for blood transfusion following Caesarean section at a local obstetrics and gynaecology unit in Hong Kong and review the need for universal blood type and screen in patients who underwent Caesarean section.
Methods: This was a retrospective cohort of all deliveries in United Christian Hospital, Hong Kong within a 3-year period from 1 January 2012 to 31 December 2014. Data on demographics, parity, previous Caesarean section/uterine scar, multiple pregnancy, antenatal complications (including anaemia, gestational hypertensive disorders, placenta praevia, placental abruption), and outcomes (postpartum haemorrhage and blood transfusion) were retrieved via the obstetrics clinical information system database.
Results: A total of 119 (3.7%) patients required intraoperative or postoperative transfusion. Univariate analysis showed that the incidence of advanced maternal age, preterm delivery, emergency Caesarean section, multiple pregnancy, as well as presence of placenta praevia and placental abruption were significantly higher in the transfusion group compared with the controls, whereas more patients had previous Caesarean section in the latter group. Multiple pregnancy (odds ratio=3.71), emergency Caesarean section (odds ratio=1.79), placenta praevia (odds ratio=9.64), and placental abruption (odds ratio=6.85) remained statistically significant factors associated with the need for blood transfusion after multivariate regression analysis. A predictive model using these four risk factors gave a sensitivity of 80.6%, specificity of 39%, positive predictive value of 4.8%, and negative predictive value of 98%.
Conclusion: The majority of patients who underwent Caesarean section did not require blood transfusion. Selective type and screen is feasible and safe and can be reserved for patients with specific risk factors.
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Keywords: Blood grouping and crossmatching; Blood transfusion; Cesarean section; Risk factors

Introduction

Caesarean section is one of the most commonly performed obstetric procedures worldwide[1]. It is associated with a higher risk of haemorrhage and blood transfusion than normal vaginal delivery (1-7% vs. 1%)[2]. Blood transfusion is thus a life-saving procedure in obstetrics as severe haemorrhage remains one of the major causes of maternal death[3]. Nonetheless, inappropriate use of blood transfusion can pose potential risks that can be life-threatening because of the potential associated risk of acute or delayed transfusion reactions and complications. Advanced techniques in accurate crossmatching and screening for blood-borne diseases and antibodies of major and minor blood groups are now routinely employed to minimise transfusion complications.

Various risk factors associated with increased blood loss during Caesarean section have been identified in previous studies, and include primiparity, multiple pregnancy, pre-eclampsia, previous Caesarean section, chorioamnionitis, placenta praevia, abnormal presentation (breech or transverse lie), abruptio placentae, pre-existing anaemia, emergency Caesarean section, and Caesarean section under general anaesthesia[4,5]. It has also been shown that the use of blood transfusion associated with Caesarean section has progressively decreased over the decades while the mean estimated blood loss has not significantly changed. In a 30-year observational study, blood transfusion rates dropped from 22% in the 1970s to only 5% in 2006 and this drop was not associated with increased maternal morbidity or mortality[6]. Traditionally, blood type and screen was performed for all patients who underwent

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Caesarean section in our unit, irrespective of whether they were elective or emergency Caesarean sections. With the decreasing need for blood transfusion in Caesarean section, and increasing evidence worldwide that type and screen is not necessary for all Caesarean sections, routine type and screen may no longer be a cost-effective practice[5]. It may place unnecessary pressure on haematology laboratory services of the hospital, particularly in the emergency setting. The present study aimed to review the need to routinely order blood type and screen for all patients who underwent Caesarean section and to explore the risk factors for blood transfusion in Caesarean section in Hong Kong, so as to determine whether type and screen for selected patients only is feasible.

Methods

This retrospective cohort was reviewed over a 3-year period in United Christian Hospital, Hong Kong. Records of all deliveries by Caesarean section from 1 January 2012 to 31 December 2014, whether elective or emergency, were retrieved from the obstetrics clinical information system database and were reviewed. Additional clinical information including demographics, parity, previous Caesarean section/uterine scar, multiple pregnancy, antenatal complications (anaemia, gestational hypertensive disorders, placenta praevia, placental abruption), and outcome (postpartum haemorrhage and blood transfusion rate) was extracted from the labour ward registry, individual clinical notes of patients, and verified with laboratory data including blood bank records.

The primary outcome measure was blood transfusion during the hospital admission for delivery. Postpartum haemorrhage was defined as blood loss of >500 ml and severe postpartum haemorrhage as >1000 ml. Advanced maternal age was defined as ≥35 years at delivery, and preterm delivery was defined as any delivery before 37 complete gestational weeks. Antenatal anaemia was defined as haemoglobin level of <110 g/L at any time during gestation. Pre-eclampsia was defined as proteinuric gestational hypertension after 20 weeks of gestation with blood pressure of ≥140/90 mm Hg on two or more occasions 4 hours apart, or one measurement of systolic over 170 mm Hg or diastolic over 110 mm Hg or in line with the department's protocol. Blood transfusion cases included all with intrapartum transfusions, and transfusions within 72 hours after operation. Univariate analysis was performed to compare demographic characteristics and outcomes of those who required blood transfusion with those who did not. Categorical data were compared using Chi-square and Fisher's exact tests. Multivariate logistic regression was then performed by including all likely factors that would affect the rate of blood transfusion, using presence or absence of blood transfusions, to delineate the significant risk factors. Data analysis was undertaken using the Statistical Package for the Social Sciences Windows version 23 (SPSS Inc., Chicago [IL], US), and a p value of <0.05 was considered statistically significant. Odds ratio (OR) and 95% confidence intervals were reported for individual risk factors.

Results

A total of 13,596 deliveries were carried out within the study period, of which 3212 (23.6%) were Caesarean sections. There were 1463 (45.5%) elective Caesarean sections and 1749 (54.5%) emergency sections. In all, 119 (3.7%) patients required intraoperative transfusion or postoperative transfusion. Within this cohort, the overall incidence of postpartum haemorrhage with blood loss of ≥500 ml was 4.7% (n=151), and the incidence of severe postpartum haemorrhage with blood loss of >1000 ml was 1.8% (n=59). Univariate analysis showed that the incidence of advanced maternal age, preterm delivery, emergency Caesarean section, multiple pregnancy, presence of placenta praevia, and placental abruption were all significantly higher in the transfusion group compared with the controls (Table 1). On the other hand, the incidence of previous Caesarean section was paradoxically lower in the transfusion group, due to the low transfusion rates within the very high proportion of elective repeat Caesarean sections for previous Caesarean section in the cohort (p=0.001). A logistic regression model using the enter technique to delineate the significant factors associated with the need for blood transfusion showed that multiple pregnancy (OR=3.71), emergency Caesarean section (OR=1.79), placenta praevia (OR=9.64), and placental abruption (OR=6.85) remained statistically significant factors associated with the need for blood transfusion (Table 2). Using these four parameters as predictors of the need for blood transfusion gave a sensitivity of 80.6%, specificity of 39%, positive predictive value of 4.8%, and negative predictive value of 98%.

Discussion

In this retrospective study, our blood transfusion rate in Caesarean section was 3.7%, similar to the reported rates in other developed countries (<1-7%)[2,6,7]. Risk factors associated with increased risk of blood transfusion, which included advanced maternal age, preterm delivery, emergency Caesarean section, multiple pregnancy, as well as presence of placenta praevia and placental abruption were similar to other studies worldwide[2,6,8-11]. In other studies,

Table 1. Epidemiological and pregnancy characteristics for patients with and without blood transfusion

	No transfusion (n=3093)	Transfusion (n=119)	p Value	Estimated number needed to treat*
Parity			0.35	
Primiparous	1469 (47.5%)	62 (52.1%)		24
Multiparous	1624 (52.5%)	57 (47.9%)		29
Advanced maternal age (≥35 years)	1290 (41.7%)	61 (51.3%)	0.047	29
Antenatal anaemia (haemoglobin level of <110 g/L)	113 (3.7%)	6 (5.0%)	0.47	11.6
Pre-eclampsia	114 (3.7%)	5 (4.2%)	0.27	24
Preterm delivery of <37 weeks	365 (11.8%)	24 (20.2%)	0.009	16
Type of Caesarean section			0.024	23
Emergency	1675 (54.2%)	77 (64.7%)		
Elective	1418 (45.8%)	42 (35.3%)		
Previous Caesarean section	1309 (42.3%)	32 (26.9%)	0.001	42
Multiple pregnancy	307 (9.9%)	29 (24.4%)	0.001	11.6
Placenta praevia	120 (3.9%)	30 (25.2%)	<0.001	5
Placental abruption	14 (0.5%)	3 (2.5%)	0.023	5.6

* No. of patients with type and screen / No. of patients transfused

Table 2. Multivariate logistic regression model of risk factors for blood transfusion

Factor	Odds ratio (95% confidence interval)	p Value
Parity	1.52 (0.91-2.53)	0.10
Advanced maternal age	1.31 (0.89-1.93)	0.17
Multiple pregnancy	3.71 (2.21-6.23)	0.001
Antenatal anaemia	0.64 (0.27-1.51)	0.31
Previous Caesarean section	0.61 (0.34-1.10)	0.10
Preterm delivery	0.61 (0.35-1.09)	0.09
Emergency Caesarean section	1.79 (1.14-2.82)	0.01
Placenta praevia	9.64 (5.84-15.90)	0.001
Placental abruption	6.85 (1.82-25.81)	0.004

pre-eclampsia and eclampsia were also associated with more blood transfusion[9,10] but this was not observed in our study. It is well established that severe pre-eclampsia can be associated with haemolytic anaemia, thrombocytopenia and coagulopathy, all of which may lead to a bleeding tendency with increased blood loss and increased need for transfusion during delivery. Nonetheless, the failure of our data to identify pre-eclampsia as a risk factor for blood transfusion could be due to the low incidence of severe pre-eclampsia and eclampsia with complications among the 3% to 4% of pre-eclampsia patients in this cohort.

Surprisingly, antenatal anaemia was not a significant risk factor for blood transfusion in our study. Compared with the results from other developed countries, Rouse et al[2] found that even mild anaemia (haematocrit concentration, 25-29%) was a significant risk factor for blood transfusion in the US. Results from Finland (OR=3.38)[6], Australia (OR=6.3)[8], Taiwan (OR=1.78)[9], and India (OR=9.93)[10] have all reported an increased risk of transfusion. The definition of antenatal anaemia in our study (<110 g/L) did not differ to others, but the incidence of severe anaemia may differ in different obstetric populations. The effects of anaemia on risk of blood transfusion in Caesarean section could be more marked in developing countries due to an increased prevalence of iron deficiency anaemia and lack of

antenatal surveillance or antenatal management to correct the anaemia. Another possible explanation for the observed difference in this cohort could be that haemoglobin after Caesarean section was only checked when there was significant blood loss or if the patient had symptoms of anaemia in the postnatal period. Nonetheless, even if mild anaemia was detected incidentally in the early postpartum period, top-up transfusion was not usually required unless the patient was symptomatic, so the impact on transfusion rates would probably be small.

Placenta praevia is known to be associated with increased risk of severe postpartum haemorrhage, ranging from 1.3% to 25.8% for singleton deliveries[12,13]. The need for blood transfusion may be used as a marker of the severity of haemorrhage. Of 150 patients with placenta praevia who underwent Caesarean section in this cohort, 30 required blood transfusion, so that the transfusion rate for placenta praevia was 20%. Even after multivariate regression analysis, placenta praevia remained the most significant factor for blood transfusion (OR=9.64). Specific high risk factors for severe haemorrhage could be identified in cases of placenta praevia and would indicate the highest risk for intraoperative blood transfusion, including placenta covering a previous Caesarean scar, previous Caesarean section, and lacunae on ultrasound suggestive of placenta accreta[14]. Careful preoperative ultrasound evaluation of all cases of placenta praevia is advisable to detect any of the possible features and, if present, a crossmatch with blood products available in the operating theatre may be warranted instead of just a type and screen.

Apart from placenta praevia, three other significant risk factors were identified after multivariate logistic regression analysis: multiple pregnancy, emergency Caesarean section, and placental abruption. It is well established that placental abruption can be associated with coagulopathy and thus increased risks for transfusion[15], while both multiple pregnancy and emergency Caesarean section have been associated with postpartum haemorrhage due to uterine atony[16]. Similar models have been reported in the literature and the risk factors identified are similar to the present study[17].

In this study, a model for predicting the need for blood transfusion and thus the need for preoperative type and screen can be produced using these four parameters, and gave a sensitivity of 80.6%, specificity of 39%, positive predictive value of 4.8%, and negative predictive value of 98%. Thus, restricting routine type and screen to patients who are going to undergo Caesarean section with these four significant factors can identify around 80% of patients who truly require a blood transfusion in Caesarean section. On the contrary, applying its negative predictive value for clinical use, patients who do not have any of these four risk factors would have 98% chance that a blood transfusion is not required and hence preoperative type and screen can probably be safely omitted.

There are no local data available on risk factors for blood transfusion in Caesarean section, nor is there any solid evidence for the efficacy of routine type and screen for every patient who undergoes Caesarean section in Hong Kong. Our data confirmed that most patients who undergo Caesarean section do not require a transfusion and provide preliminary evidence that selective type and screen is actually feasible and safe for low-risk patients who undergo Caesarean section and who have no specific risk factors for transfusion. Further prospective region-wide studies may be necessary to provide better evidence-based preoperative type and screen protocols for Caesarean section in Hong Kong to verify its effectiveness and safety. There should be contingencies in haematology laboratories to support each obstetric service to provide rapid crossmatching for emergency blood transfusion needs. Nonetheless, the screening model using the four predictive factors: multiple pregnancy, emergency Caesarean section, placenta praevia, and placental abruption can be easily applied in both elective and emergency settings to determine patients who require a routine type and screen before Caesarean section to reduce unnecessary work for the laboratory.

Declaration

The authors have disclosed no conflicts of interest.

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