Maternal and fetal outcomes following delivery in a tertiary hospital in Johannesburg, South Africa

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Background. Caesarean section (CS) rates are rising worldwide. There is growing concern regarding the possible negative impacts on maternal and fetal health.

Objective. To assess birth outcomes of CS v. normal vaginal deliveries (NVD) using the Robson 10-group classification system at a tertiary hospital in Gauteng Province, South Africa. Primary postpartum haemorrhage (PPH), neonatal Apgar scores, neonatal intensive care unit admissions and perinatal deaths were recorded.

Methods. A retrospective review of all deliveries for neonates ≥500 g during September and October 2016 was undertaken. A total of 1 443 deliveries were assessed. The data were analysed using Statistical Package for the Social Sciences version 23.

Results. There were 730 (50.6%) CSs and 713 (49.4%) NVDs. The greatest contributor to the CS rate was group 5 (15.8%). PPH occurred in 8.3% of women delivering by CS, with an odds ratio (OR) of 1.86 (95% confidence interval (CI) 1.194 - 2.900). Additionally, 3 hysterectomies were performed in the CS group. A significant difference in Apgar scores was found only at 1 minute, with higher scores in the NVD group (CS mean (standard deviation) 7.74 (2.25), and NVD 8.10 (2.11); p=0.002). Eighty-nine (11.6%) neonates delivered by CS required high care admission, with an OR of 1.865 (95% CI 1.292 - 2.692) for neonates delivered by CS.

Conclusion. The CS rate was 50.6%. Performing a CS should be weighed against the risks of the procedure. Although an understanding of some influences on the rate can be obtained, further research into indications, and protocol generation to optimise this rate, are needed to limit maternal and neonatal birth complications.

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The World Health Organization (WHO) released a statement in 1985 indicating that the optimal caesarean section (CS) rate should be around 10% - 15%.[1] However, the rate has continued to rise.[1] Among the key drivers are an increase in maternal requests due to the perception that CS is a safe procedure, financial incentive and rising litigation.[2] As a result, some have argued that the increase in the CS rate is related to non-medical indications, and therefore places the mother and child at unnecessary risk.[3]

Maternal risks associated with CS include placenta praevia, uterine rupture, antepartum and postpartum haemorrhage in subsequent pregnancies and complications of surgery.[2] The incidence of placenta praevia and placenta accreta is higher in patients with previous CS, and increases with the increasing number of CSes.[4] The cost of CS and consequent adverse outcomes place an increasing burden on healthcare costs.[2]

The concerns regarding CS are echoed in the South African (SA) 2014 - 2016 Saving Mothers report. In this report, CS was strongly associated with the risk of maternal death.[5] The CS-associated maternal mortality rate was three times higher than that of normal vaginal delivery (NVD).[5] At primary care level, the rate was found to be more than four times higher.[5] Such findings possibly indicate a lack of surgical skills and suboptimal perioperative care at primary healthcare facilities.

In addition, existing evidence suggests that CS does not necessarily improve short- and long-term neonatal outcomes.[2,6] A WHO study assessing the CS rate and pregnancy outcomes in Latin America in 2005 reported that CS was significantly associated with maternal morbidity and mortality, and that elective CS, specifically, was independently associated with fetal death.[6] In support of this, MacDorman *et al.*[7] reported on neonatal mortality data between 1998 and 2001 in the USA. They showed that the odds ratio for neonatal mortality of primary CS with no indicated risk was 2.02 compared with NVD.[7]

There is a paucity of birth-outcome data from low- and middle-income countries, especially in Southern Africa. SA was not included in the WHO study looking at CS delivery outcomes on maternal and perinatal health in Africa,[8] and was excluded from Betrán *et al.*'s[9] 2016 publication on CS trends, as data were only available for 11.7% of live births. As a result, the aim of the present study was to assess the birth outcomes of pregnancies delivered via CS v. NVD at a tertiary hospital in Gauteng Province, using the WHO-endorsed Robson classification of CS.[1] These outcomes included primary postpartum haemorrhage (PPH), defined as >1 000 mL blood loss in 24 hours post delivery (severe PPH according to the WHO),[10] neonatal Apgar scores, neonatal intensive care unit (ICU) admissions and perinatal deaths.

Methods

This study was conducted at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), a tertiary hospital in Gauteng Province, SA. Alongside KwaZulu-Natal, Gauteng has the highest number of births in SA.[11] CMJAH serves a significant proportion

of Johannesburg, receiving patient referrals from three district hospitals, seven regional hospitals and several smaller midwife obstetric units (personal communication Prof. L Chauke; cluster meeting 26 January 2019). Johannesburg is the economic hub of SA, and approximately 40% of patients seen in maternity at CMJAH are immigrants. Despite it being a tertiary hospital, the hospital caters for low-, intermediate- and high-risk cases.

A retrospective review of all deliveries occurring during September and October 2016 at CMJAH was undertaken using the Robson classification. The Robson classification groups all women admitted for delivery into 1 of 10 categories based on 5 obstetric characteristics that are often routinely collected in maternity registers.[1] These include obstetric history (parity and previous CS), onset of labour (spontaneous, induced or CS before spontaneous labour), fetal presentation or lie (cephalic, breech, transverse or oblique), gestational age (term or preterm) and number of fetuses (single or multiple) (Table 1).[1,3] It provides a standardised classification system that facilitates comparison of data between establishments, and was endorsed by the WHO in 2015 for global use in monitoring, comparing and assessing CS rates.[1] All information needed to classify patients according to the Robson grouping was collected. Additionally, indications for CS, maternal PPH and neonatal outcomes, including Apgar scores at 1, 5 and 10 minutes, birth weight, ICU admissions and early neonatal deaths within the first 7 days of life (ENND) were obtained.

The data were retrieved from the maternity registers in the labour ward and obstetric theatre, and patient files. Information regarding neonates was cross-referenced from the maternity registers and hospital records with the admissions and death registers found in the paediatric high care unit and ICU. All data were entered into an Excel (Microsoft, USA) spreadsheet.

Women who had delivered neonates weighing ≥500 g, via either CS or NVD, were eligible for the study. Perinatal deaths included stillbirths ≥500 g, and ENND.[12] This weight was chosen as it is in line with the WHO recommendation that perinatal deaths include stillbirths with a mass ≥500 g, and it is also the weight taken as viability, and used for assessment in the Perinatal Problem Identification Programme.[12] Deliveries of neonates with congenital abnormalities were excluded, as this would affect the neonatal Apgar scores or ICU admissions data. Patients with incomplete data preventing classification according to the Robson grouping were also excluded.

A minimum sample size of 1 242 was calculated for an 80% power with a 10% difference, using Stata 14 (StataCorp, USA). A study performed at Chris Hani Baragwanath Hospital (CHBAH) in Johannesburg in 2013, with a 39.4% CS rate, was used as a reference, as it is the only other study that has used the Robson classification system on a similar population group.[13]

The data were analysed using Statistical Package for Social Sciences version 23 (IBM, NY USA). Statistical analysis included χ^2 tests comparing NVD and CS outcomes, one-way multivariate analysis of variance (MANOVA) and risk estimates. Categorical variables were described using percentages and continuous variables using means (standard deviations (SDs)). $P<0.05$ was considered statistically significant.

Institutional approval for the study was granted by the chief executive officer of CMJAH, and ethics clearance from the Human Research Ethics Committee of the University of the Witwatersrand (ref. no. M161018).

Results

There was a total of 1 493 deliveries over the 2-month period. Eight patients were excluded owing to birth weight <500 g, 6 were excluded as babies had congenital abnormalities and 36 were excluded owing to missing data. As a result, 1 443 deliveries were analysed. There were 730 (50.6%) CSes delivering 765 neonates, and 713 (49.4%) NVDs of 728 neonates.

The largest number of women presenting for delivery was in group 3 (n=358; 24.8%), multiparous women with a single cephalic pregnancy ≥37 weeks with spontaneous labour without previous CS (Table 2). The greatest contributor to the CS rate was group 5, multiparous women with previous CS and a single cephalic pregnancy ≥37 weeks (n=228; 15.8%), followed by group 10 (n=114; 7.9%) and group 1 (n=111; 7.7%) (Table 2). There was a 100% CS rate in group 9, all women with abnormal lies, followed by a 90.2% rate for multiparous women with singleton breech pregnancies (group 7) (Table 2).

With regards to PPH, data were available for 1 409 deliveries (715 CS, 694 NVD). Fifty-nine of 715 deliveries (8.3%) by CS developed PPH, i.e. 4.2% of the total deliveries. Thirty-two of 694 NVDs (4.6%) developed PPH, i.e. 2.3% of all deliveries. There was a significant difference in maternal PPH rate between the CS and NVD groups (p=0.006), with an odds ratio (OR) of 1.861 for PPH at CS (95% CI 1.194 - 2.900).

In addition, 3 (0.4%) patients required hysterectomy following CS, and 4 (0.5%) underwent relook laparotomies. No patients required hysterectomy or relook following NVD, but 11 (1.5%) underwent evacuations of the uterus, and 11 (1.5%) sustained tears requiring repair. There were 12 vacuum deliveries recorded (1.7% of NVDs), and 3 forceps deliveries (0.4% of NVDs), equalling 1% of total deliveries.

Table 1. The Robson 10-group delivery classification system

Group	Description
1	Nulliparous, single cephalic ≥37 weeks in spontaneous labour
2	Nulliparous, single cephalic ≥37 weeks, induced or CS before labour
3	Multiparous, without previous CS, single cephalic ≥37 weeks in spontaneous labour
4	Multiparous, without previous CS, single cephalic ≥37weeks, induced or CS before labour
5	Multiparous, previous CS, single cephalic ≥37 weeks
6	Nulliparous, single breech
7	Multiparous, single breech, including previous CS
8	All multiple pregnancies, including previous CS
9	All single pregnancies with abnormal lies (oblique/transverse), including previous CS
10	All single cephalic pregnancies, <37 weeks, including previous CS

CS = caesarean section.

Table 2. 10-group Robson classification of all deliveries at CMJAH, September and October 2016 (*N*=1443; CS *n*=730 (50.6%))

Group	Size of overall group, *n* (%)	CS, *n*	CS delivery rate in group, %	Contribution of each group to overall CS rate (50.6%)
1	266 (18.4)	111	41.7	7.7
2	56 (3.9)	42	75.0	2.9
3	358 (24.8)	79	22.1	5.5
4	135 (9.4)	71	52.6	4.9
5	272 (18.8)	228	83.8	15.8
6	13 (0.9)	10	76.9	0.7
7	41 (2.8)	37	90.2	2.6
8	46 (3.2)	31	67.4	2.1
9	7 (0.5)	7	100	0.5
10	249 (17.3)	114	45.8	7.9

CS = caesarean section; CMJAH = Charlotte Maxeke Johannesburg Academic Hospital.

Apgar scores were assessed in both groups at 1, 5 and 10 minutes using the total number of neonates born (CS = 765 neonates and NVD = 728 neonates). A significant difference in scores was found at 1 minute using one-way MANOVA, with higher scores in the NVD group (CS mean (SD) 7.74 (2.25), NVD 8.10 (2.11); p=0.002). There was no significant difference between 5-minute (CS 8.92 (1.91), NVD 8.98 (2.12)) and 10-minute (CS 9.37 (1.69), NVD 9.33 (2.06)) scores.

Eighty-nine (11.6%) neonates delivered by CS and 48 (6.6%) neonates delivered by NVD required high care admission, with an OR of 1.865 (95% CI 1.292 - 2.692) for neonates delivered by CS v. NVD. This result was statistically significant (p=0.001). Of these high care admissions, 14 (1%) CS babies and 9 (0.6%) NVD babies were admitted to ICU. No statistically significant difference was found between these ICU admissions.

There were 44 stillbirths (rate 29/1 000), and 20 ENNDs (14/1 000), with a perinatal mortality rate of 42/1 000 for the study period. The low birth-weight rate was 18.2% (babies <2 500 g), resulting in a perinatal care index of 2.3. Thirty-three of the stillbirths were macerated, of which 12/765 (1.6%) were delivered at CS and 21/728 (2.9%) at NVD. There were 11 fresh stillbirths, 5 (0.7%) of which were delivered by CS and 6 (0.8%) by NVD. There was no statistical difference found in either of these groups, but there is the possibility of a type-2 error as the numbers are small. ENNDs occurred in 12/765 (1.6%) CS deliveries and 8/728 (1.1%) NVDs. There was no statistical difference between these groups, or between the neonatal weights.

Although not initially part of the objectives of the study, it was found that there were 156 inductions of labour (IOL) (10.8% of all deliveries), 75 (48.1%) of which went on to CS. There were 320 pre-labour CSes, making up 43.8% of CS deliveries, and 22.1% of all deliveries. Of 118 women who were suitable for trial of labour after CS (TOLAC) over the 2 months, 44 (37.3%) had successful vaginal birth after CS (VBAC) and 74 (62.7%) required CS.

Discussion

Over September and October 2016, the CS rate at CMJAH was 50.6%. The largest group presenting for delivery comprised multiparous women with no previous CS (group 3). Group 5 (multiparous women with a single cephalic pregnancy ≥37 weeks with a previous CS) was the greatest contributor to the CS rate. Of concern were the high rates of pre-labour CS (43.8% of CS) and failed IOL (48.1%), as well as the poor success rate of VBAC (37.3%). A significant difference in the PPH rates in CS v. NVD was found, with an OR of 1.861 for PPH after CS. In addition, the 1-minute Apgar scores for neonates were found to be higher in the NVD v. the CS group, with an OR of 1.865 for neonatal high care admission following CS v. NVD.

These results are consistent with those of studies showing that worldwide, the use of pre-labour CS has increased over time, which may suggest that the threshold for medically indicated CS has dropped, the use of elective CS has risen, or both.[3] High pre-labour CS rates influence the overall CS rate, and affect the contributions of groups 5 and 10, as seen in the present study. Although CS at maternal request without another indication is not permitted at CMJAH, women with previous CS are offered the option of an elective CS (group 5). Patients with two previous CSes are not given the option of TOLAC, and are booked for a prelabour CS after 38 completed weeks' gestation. Of 118 women (8.1% of total deliveries) who were suitable for TOLAC at CMJAH, only 44 (37.3%) went on to deliver vaginally. This percentage is considerably lower than Landon *et al.*'s[14] quoted success rate of 73.4%, in their 2004 article. Globally, the rates of VBAC have declined, as illustrated in the USA, with rates falling from 28.3% in 1996 to 12.7% in 2002.[14,16] With adequate counselling, management protocols and improved health services, it may be possible to increase the proportion of successful VBACs. Reducing the number of repeat CSes would be beneficial in our setting, as Group 5 is a significant contributor to overall CS rate.

Rates of IOL are also rising, and the influence of this on CS rates is controversial.[3] Over 2 months, 156 patients were induced at CMJAH, but 48.1% of these ended in a CS. This is much higher than the country estimates published by the WHO in 2015, where CS rates were <33% in all groups of induced women.[3] Our high institutional rate may be related to the patient profile, but it is also possible that our selected mode of IOL is inadequate, our use of elective induction is increasing or that our threshold for CS after induction is too low.[3]

According to the latest Saving Mothers report,[5] obstetric haemorrhage is the third leading cause of maternal death in SA, after hypertension and non-pregnancy-related infection, with 30% of deaths resulting from bleeding during or after CS. Deaths resulting from obstetric haemorrhage were considered possibly avoidable in 87.8% of cases.[5] In keeping with this report, the present study showed a significant difference in the percentages of the maternal PPH rate between CS and NVD, with an OR of 1.861 for PPH at CS. A retrospective study conducted over 1 week at CHBAH in 2015 found that 8.16% of women who underwent CS had PPH, which is very similar to our rate of 8.3%.[17] To compare this with high-income countries, the International Postpartum Haemorrhage

and Collaborative Group illustrated an increasing trend in PPH in immediate/atonic PPH in Australia, Canada and the USA, but this still only accounted for <7% of deliveries in all three countries in 2006.[18] Our high rates of PPH at CS may be related to our ratio of emergency to elective CS, our large numbers of CSes for previous CS, which are often more difficult surgeries, and the relative skill or seniority of the surgeon and anaesthetist attending the CS.

A significant difference in Apgar scores was found only at 1 minute, with higher scores in the NVD group. Babies delivered by CS had an OR of 1.865 for a high care admission compared with babies delivered vaginally. Often a CS is performed for an already compromised baby, and this may have added to the observed difference. Group 10 also contributed greatly to the CS rate. The majority of these premature babies may have required additional care regardless of delivery method.[6]

Our rates of stillbirth at 29/1 000, ENND at14/1 000 and perinatal mortality at 42/1 000 for the 2 months are all higher than the national SA figures from the 2012 - 2013 Saving Babies report[19] of 23.1, 10.6 and 33.4/1 000 for stillbirths, ENND and perinatal mortality, respectively. The resulting perinatal care index was 2.3. This may be a reflection of the complex patient profile of a tertiary hospital, but calls into question whether the high CS rate at our institution is justified. The national CS rate is half our institutional rate, at 25.7%, but our outcomes are not better than the national neonatal mortality rates.

In an effort to reduce the number of CSes and the resulting short- and long-term complications, some recommendations may be made based on the present study. Only 2.1% of NVDs, and 1% of total deliveries, were assisted. The American College of Obstetricians and Gynecologists estimates that approximately 3.3% of all their deliveries were assisted in 2013.[20] In the UK the rate has remained relatively stable at between 10% and 13%, as reported by the Royal College of Obstetricians and Gynaecologists.[21] Greater awareness, emphasis and training of doctors and midwives with regard to operative delivery may aid in avoiding CS in the second stage of labour.[15]

In the present study, primiparous patients (groups 1 and 2) comprise 10.6% of patients, and are the second largest contributor to the CS rate. An audit of indications for CS in these groups may give insight into ways to avoid a first CS, and thus reduce repeat CS. Improving hospital guidelines or training on interpretation of cardiotocographs may help to reduce CS for fetal distress.[17] Increased use of TOLAC could possibly help in reducing the size of group 5, as mentioned previously. Together, groups 6 and 7 contributed 4.7% to the overall CS rate. Greater use of external cephalic version may help to reduce CS for breech presentation.

Improving the accessibility, availability and quality of CS would take the strain off larger central hospitals such as CMJAH.[15] It was suggested in the 2014 - 2016 Saving Mothers report[5] that hospitals should be accredited to offer a CS service in SA. This would require improving the quality and safety of CS through facility and health-worker training and audit, considering the existing reports of high CS-related maternal mortality in district health establishments.[5] Finally, considering methods to increase access to contraception would assist in reducing the size of families, and aid in reducing the high CS rates found in this study among multiparous women.[15]

The Robson classification is a useful tool for assessing and comparing data; however, as it does not account for indications for CS, it gives insight into the factors contributing to the CS rate but no explanation for the differences observed.[22] Maternal and fetal factors that influence decision-making are not accounted for.[22] As a result, it is unknown how many of these CSes were unnecessary. Further studies assessing CS indications, and the seniority of the doctors making the decisions, may aid in gaining better clarity regarding the CS rate and the acceptability of its consequences. Data regarding maternal morbidity unrelated to birth trauma, in addition to maternal mortality directly related to the deliveries that took place over the 2-month period, would strengthen the quality of the study by giving better insight into the full scope of ultimate maternal complications. These were not recorded, however, as follow-up beyond the 2-month time frame was outside the scope of this study. In addition, this study is retrospective, and has the inherent limitations of inadequate record-keeping and the possible misinterpretation of data. Although an understanding of birth outcomes associated with CS v. NVD has been obtained, further research into indications for CS and protocol generation regarding assisted delivery, VBAC and better ways of monitoring fetal wellbeing in labour is needed.

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