Comparison of Caesarean sections and instrumental deliveries at full cervical dilatation: a retrospective review

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ABSTRACT

**Introduction:** This study aimed to compare instrumental vaginal deliveries (IDs) and Caesarean sections (CSs) performed at full cervical dilatation, including factors influencing delivery and differences in maternal and neonatal outcomes.

**Methods:** A retrospective review of patients who experienced prolonged second stage of labour at Singapore General Hospital from 2010 to 2012 was conducted. A comparison between CS and ID was made through the analysis of maternal/neonatal characteristics and peripartum outcomes.

**Results:** Of 253 patients who required intervention for prolonged second stage of labour, 71 (28.1%) underwent CS and 182 (71.9%) ID. There were 5 (2.0%) who failed ID. Of the maternal characteristics considered, ethnicity was significantly different. Induction of labour and intrapartum epidural did not influence delivery type. 70.4% of CSs occurred outside office hours versus 52.7% of IDs (p = 0.011). CS patients experienced longer second stage of labour (p < 0.001). Babies born via CS were heavier (p < 0.001), while the ID group had a higher proportion of occipitoanterior presentations (p < 0.001). Estimated maternal blood loss was higher with CSs (p < 0.001); neonatal outcomes were similar.

**Conclusion:** More than one out of four parturients requiring intervention for prolonged second stage underwent emergency CS. Low failed instrumentation rates and larger babies in the CS group suggest accurate diagnosis of cephalopelvic disproportion. Higher incidence of CS after hours suggests trainee reluctance to attempt ID. There were no clinically significant differences in maternal and neonatal morbidity.

**Keywords:** Caesarean section at full cervical dilatation, instrumental delivery, labour intervention, prolonged second stage, trial of delivery
INTRODUCTION

The recent years have seen a worldwide increase in the rates of Caesarean deliveries.\(^{(1-4)}\) This can be attributed to several reasons including lower procedure-related risks, increasing incidence of maternal requests and multiple pregnancies due to advances in fertility treatment.\(^{(5,6)}\) While these factors account mostly for the rise in elective Caesarean sections (CSs), there has been a similar increase in the proportion of emergency CS performed.\(^{(7)}\)

Emergency CS may be further categorised into those performed in either the first or second stage of labour, depending on whether there is an arrest of dilatation or arrest of descent. First stage of labour is defined as the duration from the beginning of labour until full cervical dilatation, while second stage of labour refers to the fetal descent and expulsive phase after reaching full cervical dilatation. In managing patients experiencing a prolonged second stage of labour, obstetricians are faced with the choice of two interventions: instrumental vaginal delivery (ID) or CS. The eventual decision depends on several factors, of which the obstetrician’s clinical judgment regarding the cause of arrest of descent, the appropriateness of the intervention in the given clinical context, the obstetrician’s proficiency in carrying out either intervention and maternal opinion are especially significant. In some cases, both interventions may be attempted, such as CS after a failed attempt at ID.

An increase in the rates of emergency CS performed specifically in the second stage of labour has been documented.\(^{(8-11)}\) This reflects the decreasing popularity of attempting ID as a first line intervention in patients with prolonged second stage of labour.

Although several studies have been done to compare the prevalence of maternal and neonatal morbidity and mortality between second stage CS and ID,\(^{(12)}\) similar data is limited in the Asian population, where maternal height and pelvic dimensions, which influence the likelihood of cephalopelvic disproportion (CPD), are significantly different.\(^{(13-15)}\) Such findings are an important consideration as a clinical diagnosis of CPD precludes the use of
ID, which would hence influence the rates of IDs and second stage CSs. Additionally, no randomised controlled trial has been carried out to compare the outcomes of both types of interventions.

The aim of this study was to compare emergency second stage CS and ID performed at Singapore General Hospital (SGH) specifically for poor progress in the second stage of labour over a three-year period from 2010 to 2012, and to determine the rates of IDs compared to CSs for poor progress in the second stage of labour, the factors influencing the eventual mode of delivery, and if there was a difference in maternal and neonatal outcomes between both groups.

METHODS
Patients were identified via the labour ward database maintained at SGH. We included women with singleton, vertex pregnancies who required either an emergency CS at full dilatation for clinically diagnosed CPD or ID for prolonged second stage between 1 January 2010 and 31 December 2012. For nulliparous women, prolonged second stage was defined as greater than three hours with an epidural and greater than two hours without an epidural; in multiparous women, it was defined as greater than two hours with an epidural and greater than one hour without an epidural. Medical records for these patients were obtained and appropriate data was extracted.

We considered maternal and neonatal characteristics and outcome measures, as well as labour factors including presence of any perinatal complications. Maternal characteristics included maternal age, ethnicity, gestational age, body mass index (BMI), gravidity, parity, and presence of any documented risk factors such as smoking, advanced maternal age (defined as maternal age more than 35 years), gestational and pre-existing diabetes mellitus, asthma, anaemia, maternal hyper- or hypothyroidism, pre-existing hypertension, pregnancy-
induced hypertension or preeclampsia, cardiac disease and Group B streptococcus positivity. Maternal outcome measures that were considered were estimated blood loss, incidence of maternal morbidity and length of hospital stay. Neonatal characteristics included head position and fetal weight, and neonatal outcome measures comprised neonatal intensive care unit (NICU) admission, neonatal trauma and APGAR score at five minutes. Labour factors considered included duration of second stage, spontaneity of labour, epidural use, instrument type in IDs, perinatal complications, such as premature rupture of membranes, and maternal pyrexia as well as time of delivery, with office hours being taken as 0800–1800 hours (Table I).

Table I. Maternal and neonatal demographics.

| Maternal characteristics | • Maternal age  
|                        | • Ethnicity  
|                        |   - Chinese  
|                        |   - Non-Chinese (Malay, Indian, Others)  
|                        | • Gestational age  
|                        | • Body mass index  
|                        | • Parity  
|                        | • Risk factor  
|                        |   - Smoking  
|                        |   - Advanced maternal age (> 35 years old)  
|                        |   - Gestation/pre-existing diabetes mellitus  
|                        |   - Asthma  
|                        |   - Anaemia  
|                        |   - Thyroid dysfunction  
|                        |   - Pre-existing hypertension/PIH  
|                        |   - Preeclampsia  
|                        |   - GBS positive  
|                        |   - Cardiac diseases  
| Neonatal characteristics | • Head position at delivery  
|                        | • Birth weight  
| Maternal outcome measures | • Estimated blood loss  
|                        | • Incidence of maternal morbidity  
|                        | • Duration of hospital stay  
| Neonatal outcome measures | • APGAR scores  
|                        | • Major neonatal morbidity/trauma  
|                        | • NICU admission  
| Labour factors | • Duration of second stage of labour  
|                        | • Induction of labour  
|                        | • Epidural use  

GBS: Group B Streptococcus; NICU: neonatal intensive care unit; PIH: pregnancy-induced hypertension

Our study was exempted from the application of formal ethics approval by the SingHealth Centralised Institutional Review Board, which is the main body involved in approving, monitoring and review of any biomedical and behavioural research involving humans.

RESULTS

A total of 4,426 deliveries were performed, of which 253 (5.7%) patients required intervention for prolonged second stage of labour. ID was attempted in 187 patients, while 66 patients were listed directly for emergency CS. Of the 187 attempted IDs, five were unsuccessful and eventually underwent delivery via CS, resulting an instrumental delivery failure rate of 2.7%. 182 women eventually underwent delivery by ID and 71 by CS. From 2010 to 2012, there was a 3.6% increase in the proportion of second stage CS performed, with a corresponding decrease in the proportion of ID performed (Figs. 1–3).

There were no significant differences in maternal BMI (p = 0.288), age (p = 0.462), parity (p = 0.831), gestational age (p = 0.899) at delivery, or maternal risk factors between both groups. However, there was a significantly higher rate of CS deliveries amongst Chinese compared to non-Chinese (Malay, Indian, Others) mothers (p = 0.007). Neonates born via CS were on average about 200 g heavier (p < 0.001), and there was a significantly larger proportion of occipitoanterior presentations in the ID group (p < 0.001). Time of delivery played a significant role in the mode of delivery, with approximately one in five CSs performed for prolonged second stage labour during office hours, compared to the one in
three CSs seen after office hours (p = 0.011). The average duration of the second stage of labour was also significantly longer in the CS group (p < 0.001); however, induction of labour (p = 1.000) and epidural use (p = 0.121) did not have a significant impact on the mode of delivery.

With regard to outcomes, mothers in the CS group had a significantly higher estimated blood loss (p < 0.001). There were no major maternal morbidity and intensive care unit admissions, and neonatal outcomes were comparable between both groups (Tables II–IV).

### Table II. Maternal demographics (n = 253).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Instrumental vaginal delivery (n = 182)</th>
<th>Caesarean section (n = 71)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (yr)</td>
<td>30.6 (19–44)</td>
<td>31.0 (18–41)</td>
<td>0.462</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.8 (16.0–42.3)</td>
<td>27.6 (20.3–42.3)</td>
<td>0.288</td>
</tr>
<tr>
<td>Gestational age (wk + day)</td>
<td>39 + 3 (34 + 2–41 + 3)</td>
<td>39 + 5 (36 + 3–41 + 1)</td>
<td>0.899</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>90 (49.5)</td>
<td>49 (69.0)</td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>39 (21.4)</td>
<td>11 (15.5)</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>19 (10.4)</td>
<td>6 (8.5)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>34 (18.7)</td>
<td>5 (7.0)</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
<td>0.831</td>
</tr>
<tr>
<td>Nulliparous</td>
<td>157 (86.2)</td>
<td>62 (87.3)</td>
<td></td>
</tr>
<tr>
<td>Multiparous</td>
<td>25 (13.8)</td>
<td>9 (12.7)</td>
<td></td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced maternal age</td>
<td>44 (24.2)</td>
<td>15 (21.1)</td>
<td>0.624</td>
</tr>
<tr>
<td>Gestational DM</td>
<td>16 (8.8)</td>
<td>3 (4.2)</td>
<td>0.292</td>
</tr>
<tr>
<td>Pre-existing DM</td>
<td>1 (0.5)</td>
<td>6 (8.5)</td>
<td>0.483</td>
</tr>
<tr>
<td>GBS positive status</td>
<td>24 (13.2)</td>
<td>1 (1.4)</td>
<td>0.388</td>
</tr>
<tr>
<td>Asthma</td>
<td>4 (2.2)</td>
<td>2 (2.8)</td>
<td>0.674</td>
</tr>
<tr>
<td>Anaemia</td>
<td>9 (4.9)</td>
<td>1 (1.4)</td>
<td>0.291</td>
</tr>
<tr>
<td>Thyroid derangements</td>
<td>3 (1.6)</td>
<td>2 (2.8)</td>
<td>0.622</td>
</tr>
<tr>
<td>Pre-existing hypertension</td>
<td>1 (0.5)</td>
<td>1 (1.4)</td>
<td>0.483</td>
</tr>
<tr>
<td>PIH</td>
<td>1 (0.5)</td>
<td>1 (1.4)</td>
<td>0.483</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>2 (1.1)</td>
<td>2 (2.8)</td>
<td>0.314</td>
</tr>
<tr>
<td>Estimated blood loss (mL)</td>
<td>250 (200–1,000)</td>
<td>300 (200–500)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

BMI: body mass index; DM: diabetes mellitus; GBS: Group B streptococcus; PIH: pregnancy-induced hypertension
Table III. Neonatal characteristics and outcomes.

<table>
<thead>
<tr>
<th></th>
<th>Instrumental vaginal delivery (n = 182)</th>
<th>Caesarean section (n = 71)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occipitoanterior</td>
<td>155 (85.2)</td>
<td>23 (32.4)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Others</td>
<td>27 (14.8)</td>
<td>48 (67.6)</td>
<td></td>
</tr>
<tr>
<td>Neonatal weight at birth (g)</td>
<td>3,189.0 ± 410.6</td>
<td>3,396.7 ± 429.9</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>NICU admission</td>
<td>8 (4.4)</td>
<td>4 (5.8)</td>
<td>0.741</td>
</tr>
</tbody>
</table>

NICU: neonatal intensive care unit

Table IV. Comparison of labour and delivery outcomes.

<table>
<thead>
<tr>
<th></th>
<th>Instrumental vaginal delivery (n = 182)</th>
<th>Caesarean section (n = 71)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature rupture of membranes</td>
<td>21 (11.5)</td>
<td>5 (7.0)</td>
<td>0.361</td>
</tr>
<tr>
<td>Maternal pyrexia during labour</td>
<td>21 (11.5)</td>
<td>6 (8.5)</td>
<td>0.651</td>
</tr>
<tr>
<td>Epidural use during labour</td>
<td>139 (76.4)</td>
<td>61 (85.9)</td>
<td>0.121</td>
</tr>
<tr>
<td>Onset of labour</td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Spontaneous</td>
<td>139 (76.4)</td>
<td>55 (77.5)</td>
<td></td>
</tr>
<tr>
<td>Induced</td>
<td>43 (23.6)</td>
<td>16 (22.5)</td>
<td></td>
</tr>
<tr>
<td>Duration of second stage (min)</td>
<td>128.9 (58.9)</td>
<td>173.7 (63.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Delivery during office hours</td>
<td>86 (47.3)</td>
<td>21 (29.6)</td>
<td>0.011</td>
</tr>
</tbody>
</table>

DISCUSSION

In keeping with worldwide trends,(16-19) the percentage of second stage CSs in our institution showed a year-on-year increase with a corresponding decrease in the percentage of IDs, reflecting growing reluctance to perform ID. The limited literature available regarding the incidence of arrest of descent report significantly different figures, ranging from 1.7% in a retrospective study by Feinstein et al(20) to the 11.5% reported by Leushuis et al.(21) The incidence reported in our study lies in between at 5.7%. This difference has been attributed to the proportion of nulliparous women included in each study, in which a higher percentage of nulliparous women is associated with a higher incidence of arrest of descent; however, this is unlikely to be the only contributing factor, as the proportion of nulliparous women in our study was higher than both previously mentioned studies at 86.6%, compared to 21% in
Feinstein et al and 45% in Leushuis et al. The incidence of CSs undertaken for prolonged second stage was marginally higher (26.3% vs. 14.8% in Leushuis et al) in our study. In cases where ID was the intervention of choice, failure rates were low compared to other reported figures,\(^{(22)}\) which could either reflect operator competence or a conservative approach in attempting ID.

Significant factors affecting the eventual mode of delivery in our study were maternal ethnicity, duration of second stage of labour, neonatal weight and head position. Ethnically Chinese mothers were more likely to undergo CS if they required intervention in the second stage. This difference could be a result of maternal choice rather than intrinsic differences in factors such as body habitus. Although our data showed a significant difference in median BMI between Chinese and non-Chinese women (26.29 vs. 28.59; \(p = 0.002\)), it is a higher, not lower, BMI that has been associated with increased risk of CS.\(^{(22)}\) This does not correspond with the findings of our study, indicating the presence of other factors influencing the final choice of intervention. Differences in the rate of both elective and emergency CSs amongst various ethnicities have also been reflected in other studies, but have never been fully accounted for.\(^{(23-25)}\) Further studies would be useful in determining the reasons for this disparity in CS rates amongst racial groups.

In our study, duration of the second stage of labour was longer in the CS compared to the ID group. This is possibly due to the fact that patients experiencing a prolonged arrest of descent were more likely to be diagnosed with CPD and hence, undergo CS rather than ID. The significant differences in fetal head position between both groups are similarly unsurprising, as fetuses presenting in the occipitoanterior position are more amenable to ID due to easier positioning of the instrument. Although malposition is not an absolute contraindication for ID, it has been associated with higher ID failure and complication rates,\(^{(22)}\) which might have swayed the obstetrician’s choice of intervention towards CS
instead. In our study, babies born in the CS group tended to be heavier, a finding consistent with available literature.\(^{(26)}\) As risk of CPD rises with increasing fetal size (with fetal weight being a surrogate measure), this suggests sound clinical judgment amongst attending obstetricians in our hospital in making a diagnosis of CPD and hence the appropriate choice of CS over ID.

Notably, our study also found that a larger proportion of ID were performed during office hours, when consultant obstetricians were present on-site and able to personally manage women experiencing a prolonged second stage of labour. Our findings are similar to those of other centres, where ‘after hour’ consultant presence in the maternity ward resulted in higher rates of instrumental deliveries and lower rates of operative deliveries.\(^{(27,28)}\) An inference can be made that non-consultant grade staff generally lack either the skill or confidence in attempting IDs when compared to consultant obstetricians, and are more likely to prefer CS in the event of prolonged second stage. This would be consistent with the declining rates of ID worldwide, a phenomenon which perpetuates a vicious cycle in which decreasing number of instrumental deliveries results in fewer opportunities for obstetric trainees, further compounding their lack of confidence and skill. The Royal College of Obstetricians and Gynaecologists (RCOG) has recently proposed 24-hour consultant cover on maternity wards\(^{(29)}\) given the growing complexity of obstetric cases and increase in operative birth rates. Although such a move would benefit maternal care, this might not necessarily lead to enhanced training and supervision for trainees. Furthermore, studies evaluating the impact of after-hour consultant cover have failed to demonstrate a significant difference in neonatal and maternal morbidity.\(^{(27)}\)

Another important factor contributing to a reluctance to attempt ID could be the increasingly litigious medicolegal climate affecting the medical community.\(^{(30)}\) This is especially so in obstetrics, which was previously described succinctly by Chou: “A perfect
Moreover, litigation rates have always been comparatively higher in obstetrics compared to other medical specialties,\(^{(32,33)}\) and this has resulted in obstetricians adopting a more conservative approach in the face of unforeseen clinical events. In this case, obstetricians might have developed a preference for emergency CS as the intervention of choice for prolonged second stage of labour in order to avoid the potential risk of failure of ID.

A trial of ID in operating theatre (ToD) has been proposed as a viable alternative to CS for anticipated difficult IDs, such that immediate recourse to CS is available in event of failure. This is not practised in our institution, and little data is available for comparison of the prevalence of ToD. Available quoted figures range from 2\% to 26\%.\(^{(34,35)}\) The RCOG Green Top Guidelines for Operative Vaginal Delivery (2011) presented a list of factors including elevated maternal BMI, estimated fetal weight over 4000g, fetal occipitoposterior position and mid-cavity deliveries, which are predictive of difficult IDs, and proposed that such deliveries should be considered for ToD, purportedly to reduce unnecessary CSs. This was based on the premise that fetal morbidities can be attributed to a delay between failed operative vaginal delivery and CS. However, several studies have highlighted the issue of a prolonged decision-to-delivery interval for cases of ToD due to the time taken for preparation and transfer.\(^{(34,35)}\) Interestingly, a Cochrane review by Majoko et al\(^{(36)}\) reported an absence of any randomised controlled trials comparing ToD versus immediate CS for anticipated difficult assisted births, resulting in a lack of convincing evidence to suggest that neonatal outcomes are comparable in both groups. The overall low rates of ToD, thus, not only reflects changing attitudes towards ID in general, but could also be attributed to the potentially increased risk of neonatal morbidity associated with prolonged decision to delivery intervals.

A comparison of maternal and neonatal outcomes showed that there were no statistical differences in neonatal outcomes between the ID and CS groups. All neonates
included in our study had a five-minute APGAR score of 7 or more, which is considered reassuring in a policy statement by the American Academy of Paediatrics Committee on Fetus and Newborn.\textsuperscript{(37)} There were also no differences in incidence of NICU admission at birth. Maternal outcomes were significantly different for estimated blood loss, with CS resulting in a marginally larger amount of blood loss. However, there were no cases of major haemorrhage, and the slight difference in blood loss is likely clinically insignificant. Existing studies comparing the differences in outcomes between ID and CS in the second stage of labour as well as those investigating outcomes of CS performed in the second stage of labour report similar results, with a general low incidence of CS associated with increased morbidity in the form of higher blood loss, longer duration of hospital stay, and uterine tear.\textsuperscript{(38,39)}

Our study was limited by its retrospective nature and its relatively small sample size. Documentation was not always sufficiently detailed, which might have affected the accuracy of our findings. However, our results do provide insight into obstetric practices in the Asian setting, which is scarcely represented in the limited available literature comparing ID and CS in the second stage of labour. Large, prospective studies would be required to better determine if there is a significant advantage of one option over the other in ambiguous clinical situations, which would be invaluable in aiding clinical decision-making.

More than one in four parturients at full dilation requiring intervention for prolonged second stage had an emergency CS. The frequency of failed instrumentation was low and babies in the CS group were larger, suggesting sound clinical judgment in diagnosing CPD at full dilatation. However, there were no attempts at ToD, and a higher incidence of CS after hours without in-house consultants suggests trainee reluctance to attempt instrumental delivery. This could indicate cautiousness given an increasingly litigious medicolegal environment as well as decreased clinical experience. Neonatal and maternal outcomes were also found to be clinically insignificant between both intervention methods.
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Fig. 1 Flowchart shows the successful ID attempts in prolonged second stage. ID: instrumental vaginal delivery.

Fig. 2 Graph shows the change in Caesarean section (CS)/instrumental vaginal delivery (ID) rates performed for prolonged second stage from 2010 to 2012.