Effect of twin-to-twin delivery interval on umbilical cord blood gas in the second twins

Tak-Yeung Leung*, Wing-Hung Tam, Tse-Ngong Leung, Ingrid Hung Lok, Tze-Kin Lau

Objective To examine the effect of twin-to-twin delivery interval on the umbilical cord blood gas status of the second twin following vaginal delivery.

Design A retrospective study.

Setting The department of obstetrics and gynaecology in a university teaching hospital.

Population Twin deliveries at or beyond 34 weeks of gestation over a period of five years, with the first twin delivered vaginally. Twins with any antepartum complications including discordant growth, intrauterine growth restriction, intrauterine death, fetal malformations and pre-eclampsia were excluded.

Methods The correlation between the twin-to-twin delivery interval, and both the umbilical arterial and venous blood gas parameters of the second twin, including pH, partial pressure of CO₂ and base excess, were studied.

Results A total of 118 cases were reviewed. The mean gestation at delivery was 37.1 weeks. The median twin-to-twin delivery interval was 16.5 minutes. There were significant negative correlations between twin-to-twin delivery interval and both the umbilical cord arterial and venous pH and base excess of the second twin (P < 0.05). There were also significant positive correlations between both arterial and venous partial pressure of CO₂ and the delivery interval (P < 0.05). Similar changes were found even if the analyses were limited to those who had normal vaginal deliveries. The umbilical arterial pH of Twin 2 was < 7.00 in none of the cases delivered within 15 minutes of the birth of Twin 1, 5.9% if within 16–30 minutes, and 27% if more than 30 minutes. Among those with an inter-twin delivery interval of more than 30 minutes, 73% had cardiotocographic evidence of fetal distress which required operative delivery.

Conclusions Umbilical cord arterial and venous values of pH, partial pressure of CO₂ and base excess of the second twin deteriorate with increasing twin-to-twin delivery interval. Risks of fetal distress and acidosis in the second twin are high when the twin-to-twin delivery interval is beyond 30 minutes.

INTRODUCTION

Vaginal delivery of the second twin remains a challenge in obstetric practice. Uterine inertia, abnormal lie or high presenting part of the second twin may occur after the vaginal delivery of the first twin, making delivery of the second one more difficult. There is also an increased risk of premature placental separation and cord prolapse. These factors are associated with risks of fetal distress and operative deliveries, and the risks increase with the time for the delivery of the second twin. Early studies reported a higher perinatal mortality and morbidity of the second twin associated with a prolonged interval.

It has been widely advocated that the inter-twin delivery interval should be preferably within 15 minutes and certainly not more than 30 minutes. Various manoeuvres such as the use of oxytocin, breech extraction or instrumental delivery have been used to shorten the delivery time of the second twin. However, there is a lack of scientific evidence on the ‘safety’ time limit of twin-to-twin delivery interval. Moreover, the manoeuvres used to expedite delivery of the second twin were not without potential complications.

Similar to the management of second stage in singleton pregnancies, any attempts to limit the twin-to-twin delivery interval by an arbitrarily defined cutoff undoubtedly increases the use of instrumental delivery or caesarean section, which may result in unnecessary fetal and maternal morbidities. More recent studies have shown there is no increased risk in perinatal mortality or reduction in Apgar scores of the second twin when the delivery interval was prolonged. Therefore, it has been argued that there should not be a limit to the twin-to-twin delivery interval, as long as fetal condition is monitored with continuous cardiotocogram.

However, fetal damage or hypoxia might not be accurately reflected by Apgar scores or perinatal mortality alone. Studies that have focused on blood gas status of the second twin have shown that both umbilical arterial and venous
blood gas status are poorer in the second twin, compared with the first twin. However, there are no published data concerning the rapidity of the deterioration in umbilical blood gas status with increasing duration of delivery interval.

The current study was performed to investigate the relationship between cord blood gas status of the second twin and twin-to-twin delivery interval. The rate of deterioration in cord blood gas status may provide important information on whether an upper limit of twin-to-twin delivery interval is necessary.

**METHODS**

All twin deliveries over a period of four years and nine months were identified from the computerised records system in a university teaching hospital which had an average annual delivery rate of 6500. Deliveries with the following factors were excluded:

1. Delivery before 34 weeks of gestation.
2. The first twin (Twin 1) delivered by caesarean section.
3. Intrauterine death of either one of the twins before the onset of labour.
4. Discordant growth as defined by the discrepancy of birthweight by more than 20%.
5. Pregnancies complicated by pre-eclampsia, intrauterine growth restriction, twin–twin transfusion or fetal malformations.

Information, including maternal age, parity, maternal or fetal complications, gestational age, birthweight, duration of the second stage, presentation and mode of delivery, was retrieved from the obstetric database and medical notes. Twin-to-twin delivery interval was defined as the time interval between the deliveries of the first twin (Twin 1) and that of the second twin (Twin 2). The results of cord arterial and venous blood gas analysis, which included pH, partial pressure of carbon dioxide (pCO₂) and base excess of both twins were obtained. The relationships between blood gas status of all Twin 2 and twin-to-twin delivery intervals were studied by Pearson’s correlation coefficient. The rate of change in pH with twin-to-twin delivery interval was also analysed by linear regression.

The intrapartum management of all twin pregnancies in the unit followed a unit protocol. All uncomplicated twin pregnancies with the first twin in cephalic presentation were allowed a trial of labour, regardless of the presentation of the second twin. Labour was induced after 38 weeks of gestation if the woman remained undelivered. During the intrapartum period, both twins were monitored with continuous cardiotocogram, using fetal scalp electrode for the first twin and external transducer for the second twin. Epidural analgesia was offered to all patients. If agreed, epidural analgesia was administered by continuous infusion through infusion pump, and it was not the practice of the unit to further top-up in the second stage. After the delivery of the first twin, oxytocin infusion was commenced within 15 minutes if uterine contractions were inadequate. Immediately after the delivery of each twin, the umbilical cord was double-clamped and labelled. Blood samples were obtained from both the umbilical arteries and umbilical veins after delivery, with precaution not to mix up the arterial and venous samples. These samples were analysed immediately for arterial and venous pH, pCO₂ and base excess, using a blood gas analyser (Ciba-Corning Corp, USA). The data were checked if the arterial pH was lower than the venous pH. If not, incorrect blood collection or mixing up of the blood samples was suspected and the data were discarded.

The Statistical Package for Social Sciences for Windows Version 9.0 (SPSS Inc, Illinois, USA) was used for statistical analysis of all data.

**RESULTS**

There were 329 (1.1%) twin pregnancies among 30,555 total deliveries during the study period. Fifty-three women were excluded because of preterm delivery before 34 weeks. A further 125 women were excluded because Twin 1 was delivered by caesarean section, while another 25 were excluded because of maternal or fetal complications mentioned above. Among the remaining 126 women, medical notes were available for review in 118 cases.

The mean maternal age was 29.7 years. Forty-eight (40.7%) of them were nulliparous. Twenty-six (22%) of all twin pregnancies resulted from assisted reproductive procedures.

The mean gestation at delivery was 37.1 weeks. Thirty-seven (31.4%) were delivered between 34 and 37 weeks. In 76 women Twin 1 (64.4%) had a normal vaginal delivery while the rest had an assisted vaginal delivery. Eighty-six women (72%) had oxytocin for either induction or augmentation of labour and there was no evidence of uterine hyperstimulation in any of these women. The mode of delivery of Twin 2 was normal vaginal birth in 46 (39.0%), instrumental delivery in 19 (16.1%), assisted breech delivery in 33 (28.0%), and caesarean section in 20 (16.9%). Fetal distress based on abnormal cardiotocogram was one of the indications for caesarean section in 14 cases, of which five had arterial pH < 7.0 and the other six had pH < 7.2. One had a pH of 7.2, and data were missing in the remaining two cases.

Figure 1 shows the distribution of time intervals for delivery of the second twin. The median time was 16.5 minutes (range from three to 51 minutes). The distribution of different modes of delivery at different time of delivery is shown in Fig. 2.

There was a significant relationship between twin-to-twin delivery interval and all arterial and venous blood gas parameters of Twin 2 ($P < 0.05$, Table 1). The longer the duration, the lower the pH and base excess, and the higher
the pCO₂. The rate of reduction in the arterial pH, as analysed by linear regression, was $5.29 \times 10^{-3}$ per minute (Fig. 3). To eliminate the possible effect of intervention on cord blood gas status, the analyses were repeated with the group of normal vaginal delivery alone. There was again significant correlation between the twin-to-twin delivery interval and the arterial pH, venous pH, arterial base excess and venous base excess (Table 1), and the rate of reduction in arterial pH, as analysed by linear regression, was $4.56 \times 10^{-3}$ per minute.

The arterial pH was less than 7.0 in seven of the second twins (6.6%). All of them had an abnormal cardiotocogram. Fetal distress was diagnosed in six cases and one was delivered by assisted breech delivery. In one case, vaginal delivery was imminent and the baby was born by normal vaginal delivery. The remaining five cases were delivered by emergency caesarean section. The decision for caesarean section was made within five minutes of fetal heart rate abnormality in all except one who had a trial of vacuum extraction which failed. The decision-to-delivery interval ranged from 11 to 19 minutes with a median of 12 minutes.

<table>
<thead>
<tr>
<th>Blood gas parameters</th>
<th>All cases</th>
<th>Normal vaginal delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arterial pH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>$-0.469$</td>
<td>$-0.334$</td>
</tr>
<tr>
<td>$P$ value</td>
<td>$&lt;0.001^*$</td>
<td>$0.015^*$</td>
</tr>
<tr>
<td>No. of cases</td>
<td>106</td>
<td>42</td>
</tr>
<tr>
<td><strong>Arterial pCO₂</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>0.333</td>
<td>0.151</td>
</tr>
<tr>
<td>$P$ value</td>
<td>$&lt;0.001^*$</td>
<td>0.173</td>
</tr>
<tr>
<td>No. of cases</td>
<td>103</td>
<td>41</td>
</tr>
<tr>
<td><strong>Arterial base excess</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>$-0.397$</td>
<td>$-0.298$</td>
</tr>
<tr>
<td>$P$ value</td>
<td>$&lt;0.001^*$</td>
<td>0.029$^*$</td>
</tr>
<tr>
<td>No. of cases</td>
<td>103</td>
<td>41</td>
</tr>
<tr>
<td><strong>Venous pH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>$-0.478$</td>
<td>$-0.454$</td>
</tr>
<tr>
<td>$P$ value</td>
<td>$&lt;0.001^*$</td>
<td>0.001$^*$</td>
</tr>
<tr>
<td>No. of cases</td>
<td>108</td>
<td>43</td>
</tr>
<tr>
<td><strong>Venous pCO₂</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>0.269</td>
<td>0.095</td>
</tr>
<tr>
<td>$P$ value</td>
<td>0.002$^*$</td>
<td>0.272</td>
</tr>
<tr>
<td>No. of cases</td>
<td>109</td>
<td>43</td>
</tr>
<tr>
<td><strong>Venous base excess</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson’s coefficient</td>
<td>$-0.395$</td>
<td>$-0.471$</td>
</tr>
<tr>
<td>$P$ value</td>
<td>$&lt;0.001^*$</td>
<td>0.001$^*$</td>
</tr>
<tr>
<td>No. of cases</td>
<td>108</td>
<td>42$^*$</td>
</tr>
</tbody>
</table>

* $P < 0.05$.

Among the 15 second twins that were delivered beyond 30 minutes, 11 (73%) showed signs of fetal distress on cardiotocogram and their umbilical arterial pH were all below 7.2. Two of these 11 cases resulted in instrumental delivery, one had assisted breech delivery, and eight were delivered by caesarean section.

The umbilical arterial pH of Twin 2 was less than 7.00 in none of the cases if delivered within 15 minutes after birth.
of Twin 1; 5.9% if within 16–30 minutes, and 27% if more than 30 minutes.

DISCUSSION

After the delivery of the first twin, there is a theoretical risk that a significant reduction in uterine volume might precipitate partial placental separation and reduction in uterine perfusion and placental circulation. Although some studies have shown a similar fetal outcome between first and second twins in terms of Apgar score and mortality rate, other studies have demonstrated that the second twin has a lower umbilical cord blood gas status. Yet, there is a paucity of literature concerning the effect of the duration of twin-to-twin delivery interval on the outcome of second twin. We believe that this information has significant clinical and medicolegal implications.

Our results show that there is significant correlation between all umbilical cord blood gas parameters of the second twin and the twin-to-twin delivery interval. The pH, pCO$_2$ and base excess of both the umbilical artery and the vein of the second twins deteriorated as the twin-to-twin delivery interval increased. However, any relationship between blood gas status and inter-twin delivery interval might be attenuated or aggravated by medical intervention. We therefore focused on those second twins with normal delivery, and the results showed that there was still a significant inverse correlation between delivery interval and cord blood gas status. These observed changes in cord blood gas parameters were unlikely to be related to top-up of the epidural because it is the practice of the unit to give continuous infusion for epidural analgesia. The use of oxytocin in the second stage could be a potential confounding factor. Unfortunately, due to the retrospective nature of the current study, a detailed analysis of this variable was not possible. However, we believe that this effect, if any, would be small since there was no evidence of uterine hyperstimulation in any of our subjects. Our findings confirm an association, although not a causal relationship, between the twin-to-twin delivery interval and the cord blood gas status of the second twins. Nonetheless, these data support previous speculations that placental transfer might diminish after the birth of first twins, leading to a deterioration in blood gas status of the second twin. Most conclusive evidence, however, would require further study with serial measurements of scalp pH of Twin 2 during the twin-to-twin delivery interval.

In our series, five of the seven cases with severe acidosis, defined as an arterial cord pH $< 7.17$, were delivered by caesarean section, although the decision for intervention was made within five minutes of fetal heart rate abnormalities and the median decision-to-delivery interval was 12 minutes. The occurrence of severe acidosis in these women was unlikely to be due to a delay in intervention, because a recent report of Level 3 obstetric units have shown that the median decision-to-delivery intervals for urgent caesarean sections for abnormal fetal blood sample, failed instrumental delivery and cord prolapse were 33 minutes, 22 minutes and 28 minutes, respectively. Our findings suggest that deterioration of cord gas status might be very rapid once cardiotocographic abnormalities have occurred. Alternatively, these fetuses might have been compromised before the onset of labour and started with an abnormal cord blood gas. However, this was unlikely because these women were highly selected without any antenatal complication, and the intrapartum cardiotocogram were normal except immediately before intervention.

The results of this study may have important implications. Firstly, continuous fetal heart monitoring of the second twin is mandatory since all newborn babies with severe acidosis had cardiotocographic evidence of fetal distress. However, continuous fetal heart monitoring alone may not be sufficient in preventing fetal acidosis because of the rapidity of changes in acid–base status. Secondly, experienced obstetricians, anaesthetists and paediatricians should be present after the delivery of the first twin, and immediate access to the operating theatre should be secured throughout. Thirdly, the threshold for intervention by either instrumental or abdominal delivery must be low to avoid any further fetal compromise. Lastly, a time limit for twin-to-twin delivery interval may be considered justified.

Setting a time limit requires the balance between the risks of early intervention by operative delivery and its associated morbidity, and that of late intervention which include permanent fetal hypoxic damage. Our observations showed that if the second twin remained undelivered after 30 minutes of the birth of the first twin, the risk of severe fetal acidosis was 27%, and the risk of fetal distress requiring obstetric intervention was as high as 73%. On the other hand, all normal vaginal deliveries of the second twins occurred within 30 minutes. We acknowledge that, due to the retrospective nature of the current study, we were unable to exclude all possible bias. However, in the absence of better evidence, a 30-minute standard for twin-to-twin delivery interval might be the best compromise.

In conclusion, we have shown that increasing twin-to-twin delivery interval was associated with worsening of umbilical cord arterial and venous pH, partial pressure of CO$_2$ and base excess of the second twin. Risks of fetal distress and acidosis in the second twin are high when the twin-to-twin delivery interval is beyond 30 minutes. Further study is required to confirm the value of the practice of setting a time limit to the delivery interval.

References


Accepted 10 September 2001