Risk Factors and Clinical Presentation of Uterine Rupture in the Unscarred Uterus: A Case Control Study

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Abstract

Purpose: The aim of our study was to determine the risk factors and to describe the clinical presentation of women with uterine rupture without previous caesarean delivery.

Methods: Case-control study involving all cases of uterine rupture in the unscarred uterus detected during labour or in the post-partum between January 1, 2004 and April 1, 2016. For the control we included four controls for one case among all the patients with no record of previous caesarean delivery and planned vaginal delivery in the same period.

For each woman we collected the maternal and labour characteristics. We evaluate the risk factors of uterine rupture, using Bayesian’s method. Each result is presented as a differential with a 95% credibility interval and the probability that the difference is greater or less than 0 (or 1 for the odds ratio).

Results: We identified seven cases of spontaneous rupture. Deep and variable decelerations were the most frequent abnormal fetal rhythm. There was not maternal death but one neonatal death. Multiparity (estimated difference of 1.59 (95% CI=0.55, 2.95) Pr (diff>0)=1); use of oxytocin (OR=26.4 (95% CI=1.79-103) Pr (diff>0)=0.99), induced labour (OR=14 (95% CI=2.5, 122) Pr (diff>0)=1) ultrasound macrosomia (OR 30.0 (95% CI=4.3-327) Pr (diff>0)=0.99), were associated with uterine rupture.

Conclusion: Even in developed countries, uterine rupture remains a serious complication with high maternal and fetal morbidity. We identified some risk factors like multiparity, induction of labour and macrosomia. These factors can help us to detect earlier this complication.

Keywords: Uterine rupture; Unscarred uterus; Case-control study; Maternal morbidity; Fetal morbidity

Abbreviations: FHR: Fetal Heart Rate

Introduction

Uterine rupture is a rare obstetric complication associated with significant fetal and maternal morbidity. Complete rupture, in which there is discontinuity of both the serosa and muscle, is the most serious type of rupture [1]. Complete rupture can occur in the scarred or unscarred uterus.

Uterine rupture in the unscarred uterus is rare and its incidence is higher in developing (between 0.1 and 1% [1]) than in developed countries. The prevalence of this event in developed countries varies according to the reporting authors and is estimated at 3/10 000 [2]. Unscarred uterine rupture accounts for only 13% of all uterine ruptures [3].

Since uterine rupture in the unscarred uterus is a very rare event, delay in the time taken to make the diagnosis is more common than with a rupture in the scarred uterus [1]. It is also associated with a more severe maternal and fetal prognosis than uterine rupture in the scarred uterus [3,4]. Lastly, uterine rupture in the unscarred uterus is a diagnostic problem since the clinical signs are not specific and vary according to the studies [3].

A better understanding of this entity could help the diagnosis to be made earlier and treatment to be improved.

The aim of this study is to analyze the risk factors and clinical presentation of uterine rupture in the unscarred uterus.

Materials and Methods

This was a case-control study involving all cases of complete uterine rupture in the unscarred uterus detected during labour or in the post-partum between January 1, 2004 and April 1, 2016 in the department of gynecology and obstetrics within the Strasbourg University Hospitals group (level three maternity units).

We did not consider cases of rupture in a scarred uterus, rupture secondary to an abdominal injury and those secondary to an ectopic pregnancy.

Specific data collection was conducted using the DIAMM® digital patient dossier.

For each case we collected the following: maternal history, features of the pregnancy in labour, clinical signs and the method of diagnosing...
uterine rupture, fetal mortality, its subsequent course and the maternal outcome.

In our institution, management of induction took place in accordance with a predefined protocol. If the status was unfavourable (Bishop score [5] of less than 6), different medications could be considered:

- **Cytotec®** (misoprostol) in a dose of 25 µg every 4 h with a maximum of 4 doses every 24 h until the onset of labour. An interval of 4 h had to be observed between oxytocin and the last insert of misoprostol. If there was no evidence of onset of labour, a second day of induction with misoprostol could be implemented.

- **Propess®** (dinoprostone) 10 mg: insertion for 24 h with a reassessment every 6 h. There was no interval between removing Propess® and initiating oxytocin. If the women did not go into labour, she was prepared for a second day of induction with Prostine®.

- **Prostine®** (dinoprostone) 1 mg or 2 mg: Application of the gel followed by reassessment every 6 h with a maximum use of 4 mg every 24 h.

The attending obstetrician decided which product should be used, bearing in mind that as of March 2013 induction with misoprostol was discontinued in our institution in keeping with the recommendations [6].

Oxytocin was infused via an electric syringe. The initial flow rate was 2 mIU/min, which was stepped up every 30 min by 2 mIU/min until a regular and appropriate uterine activity had been obtained. The oxytocin infusion rate was stopped or reduced if there was any anomaly of the fetal heart rate and stepped up again after it had been stable for a reassuring period. In the event of induction with misoprostone or dinoprostone, the recording was not continuous. Fetal heart rate (FHR) recording was continuous only when oxytocin was administered.

During labour, uterine activity and the fetal heart rate were continuously recorded by external tocography. Once the women had gone into labour (regular and painful contractions accompanied by cervical changes), she was offered epidural anesthesia. Labour was managed in line with the latest international recommendations [7].

During the latent phase (less than 6 cm dilatation), cesarean section was indicated if dilatation failed to progress over 4 h in spite of spontaneous or induced rupture of the membranes and good uterine dynamics. During the active phase (6 cm dilatation and more), cesarean section was indicated if dilatation failed to progress over 3 h for a nulliparous women and over 2 h for multiparous women in spite of good uterine dynamics.

We compared patients who had presented uterine rupture to a control population. In order to do so, we randomly selected patients presenting the following characteristics over the study period: Delivery in the same maternity unit, no previous history of Cesarean section and not presenting any indication for elective Cesarean. We assigned four controls to each case in a random, unmatched manner. 24 controls were selected from a total of potential controls. The same characteristics as in the positive cases were collected for the controls.

In view of the small number of cases, we conducted statistical analysis to evaluate risk factors for uterine rupture using the Bayesian method [8], software version R 3.0.0 and all the packages required for analysis as well as the WinBUGS® program.

Each result is presented as a differential with a 95% credibility interval and the probability that the difference is greater or less than 0 (or 1 for the odds ratio).

Continuous variables are displayed as mean and standard deviation and categorial variables as the percentage in each category.

This study followed the STROBE guidelines and was approved by the French National Data Protection Authority (CNIL) under number 1900875 v 0.

### Results

During this 12 years period, 24824 deliveries were recorded in women with an unscarred uterus. Seven cases of uterine rupture were collided during this period (1/3546), i.e., an incidence of 0.028%.

Maternal characteristics are described in detail in Table 1. None of the women with uterine rupture had a diagnosis of endometriosis. None of the women had a story of uterine surgery. None of the women was nulliparous and two (29%) had more than two previous children (four and six).

<table>
<thead>
<tr>
<th>Maternal characteristics</th>
<th>N or mean ± SD</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>35.3 ± 2.8</td>
<td>71</td>
</tr>
<tr>
<td>Termination of pregnancy</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gestity</td>
<td>4.6 ± 2.1</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td>2.4 ± 1.9</td>
<td>-</td>
</tr>
<tr>
<td>Para=0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Para=1</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>Para ≥ 2</td>
<td>4</td>
<td>67</td>
</tr>
<tr>
<td>BMI before pregnancy (kg/m²)</td>
<td>29.2 ± 5.7</td>
<td>-</td>
</tr>
<tr>
<td>BMI after pregnancy (kg/m²)</td>
<td>33.8 ± 6.6</td>
<td>-</td>
</tr>
<tr>
<td>Weight gain (kg)</td>
<td>18.6 ± 9.5</td>
<td></td>
</tr>
<tr>
<td>Fundal height (cm)</td>
<td>36.3 ± 2.3</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1:** Maternal and pregnancy characteristics of the women with uterine rupture (SD: Standard Deviation, BMI: Body Mass Index).

Characteristics of labour and clinical signs preceding rupture are described in Table 2. We noted an induction of labour for 71% of cases. The reason of labour induction was: macrosomia for two cases and for one case it was associated to gestational diabetes, abnormal fetal rate, post term and reduction of fetal movement. Irrespective of the method used to initiate labour, oxytocin was used for all women in a maximum dose of 6 mIU/h. All women received epidural analgesia.

For the clinical signs we noted that, in all cases, the existence of FHR anomalies was observed; in 71% of cases this involved deep and variables decelerations and for the others it was bradycardia. There was one instance of hypokinesia.
Two cases (33%) occurred in the post-partum: one was diagnosed during the third stage of labour and the other one, on the fourth post-partum day. When diagnosis was made in the post-partum, signs in common with the other cases were the occurrence of external bleeding and the existence of fetal distress on birth (Apgar score 1 and 2 at 1 min from birth).

Five women (71%) had Cesarean section owing to FHR anomalies, one had obstetrical maneuvers and one giving birth normally (Table 2).

<table>
<thead>
<tr>
<th>Patients</th>
<th>Time of discovery</th>
<th>Location of uterine rupture</th>
<th>Treatment of uterine rupture</th>
<th>Units of blood transfusion</th>
<th>Post giving birth complication</th>
<th>Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>4 days after giving birth</td>
<td>Complete uterine isthmus</td>
<td>Therapeutic abstention</td>
<td>3</td>
<td>Post-partum endometritis</td>
<td>No desire of reconceive</td>
</tr>
<tr>
<td>Case 2</td>
<td>Caesarean at full cervical dilatation after fail of fetal extraction</td>
<td>Complete left lateral side of uterus up to the cervix</td>
<td>Uterine repair by laparotomy</td>
<td>2</td>
<td>Post- partum endometritis</td>
<td>Desire of pregnancy with no success</td>
</tr>
<tr>
<td>Case 3</td>
<td>During surgery for major obstetric hemorrhage after giving birth</td>
<td>Left lateral side of uterus with lesion of uterine left artery</td>
<td>Hysterectomy</td>
<td>3</td>
<td>None</td>
<td>-</td>
</tr>
<tr>
<td>Case 4</td>
<td>Caesarean at full cervical dilatation</td>
<td>Complete left posterior wall of uterus up to the Pouch of Douglas</td>
<td>Uterine repair by laparotomy</td>
<td>None</td>
<td>None</td>
<td>One pregnancy six years after. Planned caesarean</td>
</tr>
<tr>
<td>Case 5</td>
<td>Caesarean at full cervical dilatation</td>
<td>Complete left and right lateral side of uterus</td>
<td>Uterine repair by laparotomy</td>
<td>None</td>
<td>None</td>
<td>Lost of follow-up</td>
</tr>
<tr>
<td>Case 6</td>
<td>Caesarean at three cm cervical dilatation</td>
<td>Complete upper anterior segment</td>
<td>Uterine repair by laparotomy</td>
<td>None</td>
<td>None</td>
<td>No desire to reconceive</td>
</tr>
<tr>
<td>Case 7</td>
<td>Caesarean at full cervical dilatation</td>
<td>Isthmus and left lateral side of uterus</td>
<td>Hysterectomy</td>
<td>None</td>
<td>None</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3: Uterine rupture and post-operative treatment of the women with uterine rupture.
With regard to the maternal characteristics potentially at risk of uterine rupture, we analysed the different potential risk factors found in the literature.

Univariate Bayesian analysis brought to light different variables which have a high probability of being risk factors. From the maternal standpoint: advanced age, increased parity and overweight carry a high probability of being risk factors for uterine rupture (Table 4). From the obstetric standpoint, increased uterine fundal height, suspected macrosomia on ultrasonography, induction of labour, and use of oxytocin even at a low dose appeared to be highly probable risk factors for uterine rupture. Duration of labour, however, did not appear linked to the occurrence of uterine rupture.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Case women(mean)</th>
<th>Control women (mean)</th>
<th>Mean OR</th>
<th>Diff</th>
<th>Statistical analysis</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Age (years)</td>
<td>34.84 (± 1.23)</td>
<td>29.23 (± 1)</td>
<td>5.58</td>
<td>[2.02-8.94]</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td>2.43</td>
<td>0.78</td>
<td>1.59</td>
<td>[0.55-2.95]</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Time of labor (hours)</td>
<td>4.67 (± 0.56)</td>
<td>5.75 (± 0.5)</td>
<td>-1.09</td>
<td>[-2.72-0.53]</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Use of Oxytocin</td>
<td>100%</td>
<td>54%</td>
<td>26.38</td>
<td>[1.79-9.92*103]</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Induction of labor</td>
<td>71%</td>
<td>14%</td>
<td>14.16</td>
<td>[2.51-122.17]</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>% ultrasound macrosomia</td>
<td>71%</td>
<td>7%</td>
<td>29.99</td>
<td>[4.28-327.44]</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>14%</td>
<td>14%</td>
<td>1.11</td>
<td>[0.08-8.37]</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>Weight at the end of pregnancy</td>
<td>98 (± 11.8)</td>
<td>81 (± 3.2)</td>
<td>17</td>
<td>[-9.9-39.53]</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Weight gain (kg)</td>
<td>18.57 (± 3.6)</td>
<td>14.7 (± 1.65)</td>
<td>371%</td>
<td>[-5.06-12.1]</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>BMI before pregnancy (kg/m²)</td>
<td>29.23 (± 2.53)</td>
<td>24.34 (± 0.87)</td>
<td>4.75</td>
<td>[-1.46-10.47]</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>BMI after pregnancy (kg/m²)</td>
<td>33.81 (± 2.51)</td>
<td>29.78 (± 1.01)</td>
<td>3.88</td>
<td>[-2.07-9.63]</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Fundal height (cm)</td>
<td>36.29 (± 0.87)</td>
<td>33.11 (± 0.34)</td>
<td>3.15</td>
<td>[1.07-5.18]</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Epidural anesthesia</td>
<td>97%</td>
<td>71%</td>
<td>0.24</td>
<td>[0.83-6.57*103]</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Baby Weight (kg)</td>
<td>4.02 (± 0.3)</td>
<td>3.34 (± 0.07)</td>
<td>0.68</td>
<td>[-0.06-1.41]</td>
<td>0.97</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Univariate bayesian analysis about risk factors of uterine rupture (Diff: Estimated Difference after Integration of Prior, CI: Credibility Interval, Pr: Probability).

Fetal issue was shown in Table 2. Three infants required resuscitation, two of them with intubation and cardiac massage. The subsequent course was favourable in all the new-born except for one which unfortunately died 13 days post-natally due to neonatal asphyxia and we noted for one a unilateral plexus. None of the children were diagnosed with any congenital malformations.

Discussion

Our research identified seven cases of uterine rupture, i.e. an incidence of 1 per 3546 deliveries. It would nevertheless seem higher than that reported in some studies carried out in developed countries. In the Netherlands, for instance, an incidence of 0.8/10 000 is observed [3]. This difference may be explained however by the fact that our study took place in a maternity hospital and not in the general population: studies in the general population tend to report a lower incidence of myometrial fragility which is acquired with successive pregnancies [15]. In our study, it was observed that parity and maternal age were indeed risk factors. The other maternal risk factor found in our study was the maternal overweight (BMI mean before pregnancy: 29.2 kg/m²). Our study, just like the study by Zwart [3], shows it to be a risk factor.

For fetal factors, our research shows that suspected and real fetal macrosomia are risk factors for uterine rupture. Diabetes was not found to be a risk factor, and it is in fact safe to assume that it is fetal macrosomia and not gestational diabetes which induces rupture following induction. Existence of a presentational dystocia and instrumental extraction are risk factors according to the studies in developing countries [14-17]. However, neither presentational dystocia nor length of labour proved to be risk factors for uterine rupture. In our institution, use of ultrasonography in the labour room and regular monitoring of progression of labour by a midwife allow us to establish early diagnoses of presentational abnormalities. We thereby avoid those cases of uterine rupture due to fetal presentation dystocia which are described in developing countries.

For obstetrical factors the time of labour is not a risk factor in our study. We can explain by the regular monitoring of progression of...
labour by a midwife allow us to establish early diagnosis of failure to progress to full dilatation, and thus to carry out Cesarean section promptly. The other obstetrical parameters: The inductions of labour, use of epidural anesthesia, use of oxytocin are found to be risk factors with high probability.

Perinatal surveys suggest that the rate of induction is higher in France than in the Netherlands: 22.7% in France (12% in the Netherlands [10]). This may therefore be a factor accounting for the higher rate of uterine rupture in the unscarred uterus in our study population. Induction of labour was observed in 5 out of 7 cases, and oxytocin was routinely administered to all patients. Induction of labour is a known risk factor for uterine rupture whether brought about with prostaglandins such as misoprostol, dinoprostone, or by use of oxytocin [3,11,15,18] in spite of them being used in compliance with the recommendations.

With the recent Boulvain et al. study [19] suggesting that induction of labour significantly reduced the risk of shoulder dystocia or associated morbidity compared with expectant management for the patient with macrosomic fetus we will noted, in the future, an augmentation of induction of labour for patient with macrosomic fetus. This increase could induce more uterine rupture of unscarred uterus.

When using misoprostol, it is important not to exceed the dose of 25 µg intravaginally and to observe an interval of 4 to 6 h between administered doses [20]. Currently in France, the National Agency for the Safety of Medicines and Medical Products (ANSM) has warned against using Misoprostol to induce labour with a viable fetus [6].

Use of oxytocin in the course of labour is a risk factor for uterine rupture which is found in many instances in the literature [2,3,18,21], especially in multiparous women. The practical methods for administering oxytocin are however not always the same. In the study by Ahamdi [21], there was no automated monitoring of the infusion flow rate, or of the tocogram. The risk of hyperkinesia and uterine hypertonia was therefore major. In our series, oxytocin was routinely used, but in low doses via an electric syringe. Nevertheless, even in the event of controlled administration in our study, as in all other studies, use of oxytocin remains a risk factor [11].

Epidural anesthesia was found to be a risk factor in others study [3,2]. The point in the studies that epidural anesthesia can masked the abdominal pain.

Uterine rupture occurs most frequently during labour, a tetrad of signs exists in theory in which acute abdominal pain, signs of shock, vaginal bleeding and deterioration of the FHR are found in association. However, all four aspects are only irregularly found together [12,18]. In our series, no women displayed all these clinical signs concurrently. In our series, the type of FHR anomaly most often observed was severe decelerations. This is, in fact, the sign most frequently found in the studies between 46 and 80% of cases [12,13,22]. This anomaly is the most commonly described [21,23] along with bradycardia [12,13,23]. Hemorrhages are less often found, in 27% of cases in the study by Zwart et al. [3].

Disorders of uterine kinetics are variable, since cases of hypokinesia, hyperktonia and hyperkinesia have all been reported [11]. Hyperkinesia is found in some studies at a level of between 13% to 38% [11,13,18]. In our research, disorders of uterine kinetics are relatively non-specific. Furthermore, it has not been demonstrated that use of internal tocography enables the diagnosis of uterine rupture to be improved [24]. The two symptoms most often associated are abdominal pain and FHR anomalies (47.6%) [3].

Diagnosis of rupture in the post-partum period is more difficult; it accounts for only about 10% of uterine ruptures [3]. In our series, the diagnosis was made in the post-partum in two patients. The clinical signs found in our series were persisting copious bleeds and notion of fetal distress on delivery. Persistent hemorrhage is found in the literature as a suggestive sign of uterine rupture in the post-partum [3]. Unexplained hypovolemic shock during the post-partum should also raise suspicion of a uterine rupture [24].

Therapeutic management is, in most cases, surgical. Anesthetic management should take place concurrently and consists of treating hypovolemic shock with fluid expanders and transfusions. It is the principal cause of maternal deaths [24]. In the event of diagnosis in patients with very few symptoms in the post-partum, the best approach may be simple monitoring. We advocated this approach for one of our women. In our series the maternal prognosis was good with no maternal deaths and a single hysterectomy. The risk of recurrence in a succeeding pregnancy varies between 4 and 19% [21]. In our series, only one woman went on to have a new pregnancy. A prophylactic Cesarean section was performed prior to the onset of labour at 38 WG +6 days. It is considered prudent for the women to wait a year before she attempts to become pregnant again and to schedule a delivery by elective Cesarean [24,25].

The relevance of our study is that it bears on a significant series of cases of uterine rupture in the unscarred uterus only. Its second point of relevance is that it subjects risk factors to case-control study. Since rupture in the unscarred uterus is a rare event, a cohort study would appear to be a difficult way to study risk factors: a case-control study better suited to this incidence. Moreover, in order to study risk factors, we used the Bayesian inferential method. This method is useful since it allows low-number populations to be studied and data already published in the literature to be taken into account.

Since the frequency is very low insignificant in our institution, it should be noted that our study population is small compared to studies in developing countries.

The fetal outcome was generally favourable (6/7), but neonatal resuscitation was necessary in 57% of cases. These results correspond to other studies that found a perinatal death between 6 and 24% [2,3,12].

**Conclusion**

Uterine rupture in the unscarred uterus remains an exceptional serious uterine complication which causes high maternal and fetal morbidity. The clinical picture is often attenuated. The principal sign is FHR anomaly. The main risk factors found in the literature and in our study are multiparity, induction of labour, use of oxytocin, and suspicion of fetal macrosomia. Diagnosis of rupture may be made in the post-partum.

**References**


