Influence of Mifepristone in Induction Time for Terminations in the Second and Third Trimester

Abstract

Termination of pregnancy after the first trimester is generally carried out by medical induction. Question: The aim of this study is to investigate the effect of mifepristone before administration of the prostaglandin derivative on induction time. Material and Methods: We analysed 333 medically indicated terminations after the first trimester under the terms of § 218a Para. 2 of the German Criminal Code, in which the prostaglandin derivatives misoprostol, gemeprost or dinoprost-one were administered with or without pre-treatment with 600 mg of mifepristone. The time interval between the initial administration of prostaglandin and delivery was investigated. Using uni- and multivariate regression analysis, the effect of maternal age, body mass index, gravidity and parity, previous Caesarean sections, gestational age and the induction regimen on the induction time were analysed. Results: The average induction time was significantly shortened with mifepristone (15.1 ± 11.9 hours with mifepristone vs. 25.3 ± 24.2 hours without mifepristone [p < 0.001]). The combination of mifepristone and misoprostol was most frequently used and proved to be the most effective regimen, reducing the induction period to 13.6 ± 10.3 hours. Besides pre-treatment with mifepristone, gestational age and a history of delivery without Caesarean section were significant influencing factors in reducing the induction time. Conclusion: The induction interval can be significantly shortened by the prior administration of mifepristone. The combination of mifepristone and misoprostol or gemeprost is the most effective regimen for the medical termination of pregnancy.
Introduction
Termination of pregnancy is one of the most common surgical procedures in gynaecology and obstetrics. Each year, 50 million terminations are registered worldwide [1]. According to data from the Federal Statistical Office, almost 107,000 terminations were carried out in Germany in 2012 [2]. The majority of these were performed surgically using curettage or vacuum aspiration. However, around 10–15% of the terminations were carried out after the end of the first trimester, and medical termination was the preferred method [3,4]. The higher morbidity and maternal mortality rates of pregnancy terminations after the first trimester should be especially considered [5]. In a study carried out in the USA, Bartlett et al. showed that the mortality rate of terminations was 0.7 per 100,000, and that this increased by 38% with each week of pregnancy [5].

The prostaglandin derivatives misoprostol, gemeprost and dinoprostone are primarily used for medically-induced terminations. These substances exhibit a satisfactory level of safety and efficacy for cervical ripening, induction of labour and medical abortion [6,7]. In a previous study by our working group, we observed that 90% of pregnancy terminations occurred within 24 hours of the start of prostaglandin administration [8]. Consistent with other study groups, gestational age and parity were shown to be decisive influencing factors [9].

To shorten the induction time of pregnancy terminations, mifepristone can also be administered before the prostaglandin [7]. As a result of its anti-progestogenic effect as a competitive inhibitor of the progesterone receptor, mifepristone reduces the uterine contraction threshold and promotes cervical ripening. Mifepristone is licensed for the medical termination of pregnancy up to the 49th day of amenorrhoea in sequential use with a prostaglandin. However, the combination can also be used in more advanced weeks of pregnancy [10].

The aim of this retrospective study is to investigate the effectiveness of the combination of mifepristone with various different prostaglandin derivatives with regard to the induction interval, and to identify factors which influence the duration of induction.

Materials and Methods
In this retrospective study, all abortions carried out at the University Hospital for Women in Tuebingen between 2005 and 2012 in which prostaglandins were administered to terminate the pregnancy were evaluated. The termination had to be carried out according to §219a Para. 2. of the German Criminal Code (StGB). Terminations carried out after the legal termination period (§218a Para. 1. StGB) were not included. Fetocide was performed in the event of non-lethal abnormalities after 24 completed weeks of pregnancy.

Either misoprostol (Cytotec® 200 µg vaginally and 200 µg orally), gemeprost (Cergem® 1 mg vaginally) or dinoprostone (Miniprostingel® 2 mg vaginally) were used for induction. Prostaglandin administration was repeated at four to six hourly intervals until regular contractions were observed. Patients who had a previous history of Caesarean section received either dinoprostone or gemeprost. The induction was otherwise carried out using misoprostol or gemeprost.

The drug regimen used was chosen by the responsible gynaecologists. Since 2009, the progesterone receptor antagonist mifepristone (Mifegyne® 600 mg orally) has been administered 24 to 48 hours before the initial dose of prostaglandin. All patients were informed about the off-label use of the drugs and gave their consent for the procedure.

Partial results from 184 of the 333 pregnancy terminations evaluated in this study were published in 2011 [8]. However, this study did not describe the cases where mifepristone was administered first.

Statistical evaluation
The maternal age (years), body mass index (kg/m²), gravidity and parity (number of each), previous Caesarean section (yes/no), previous vaginal deliveries (yes/no) and gestational age (weeks of pregnancy) were recorded in a digital database for each patient.

In our previous study, we were able to show that observed abnormalities (aneuploidy, heart defects, non-immune hydrops fetalis, neural tube defects, neuromuscular or skeletal abnormalities, CNS abnormalities and other abnormalities) and changes in the volume of amniotic fluid do not have any effect on the induction period [8]. These parameters were therefore not included in this analysis.

The induction regimen (misoprostol, gemeprost or dinoprostone), previous administration of mifepristone (yes/no) and the induction time (hours), defined as the time interval between the first dose of prostaglandin and cutting of the umbilical cord, were also recorded.

Terminations were excluded from further evaluation if the drug regimen was altered during the course of a termination, if a balloon catheter was inserted, or if the termination ended with a Caesarean section.

Induction times with and without mifepristone were compared using a Student’s t-test after normal distribution had been checked using the Kolmogorov-Smirnov test. Significant parameters which influenced induction time were investigated using uni- and multivariable regression analysis. A uni- and multivariable logistic regression analysis was used to determine the significant factors which influenced the delivery within 12 hours after induction. The level of significance was set at a p-value of 0.05.

Results
Patient characteristics
The study population included 352 pregnancies. 19 (5.4%) pregnancies were excluded either because they were terminated surgically using suction curettage, because they were terminated by Caesarean section in the case of an advanced gestational age, because the medical induction regimen was altered during the course of the termination, or because a balloon catheter was inserted. A total of 333 pregnancies were therefore available for evaluation.

The median maternal age at induction was 33.0 (interquartile range IQR 28.1–37.0) years, the median gestational age was 18.7 (IQR 15.4–21.6) weeks of pregnancy, the patients’ median BMI was 23.8 (IQR 21.5–26.6) kg/m², and the median gravidity and parity were 2 (IQR 1–3) and 1 (IQR 0–1) respectively. A Caesarean section was performed in 49 of the 177 patients with a history of previous delivery. The observed fetal abnormalities are listed in Table 1.
242 (72.7%) of pregnancies were terminated using misoprostol, 66 (19.8%) using gemeprost and 25 (7.5%) using dinoprostone. 81 (24.3%) patients initially received mifepristone (Table 2).

**Induction times and their influencing factors**

The mean induction time across the whole study group from initial drug administration to delivery was 22.8 (standard deviation ± 22.4) hours. In 123 (36.9%) patients, a maximum of 12.0 hours elapsed between the first induction and delivery. This was a maximum of 18.0 hours in 190 (57.1%) patients, and more than 24.0 hours in 235 patients (70.6%).

With mifepristone, the average induction interval was reduced significantly to 15.1 (± 11.9) hours compared to 25.3 (± 24.4) hours without mifepristone (p < 0.001) (Fig. 1). In the subgroups which were induced with misoprostol (13.6 ± 10.3 vs. 22.0 ± 22.1 hours; p < 0.001), gemeprost (11.4 ± 6.5 vs. 23.6 ± 17.9 hours; p < 0.001) and dinoprostone (37.6 ± 11.3 vs. 61.1 ± 33.4 hours; p < 0.015), the average induction interval was significantly shorter following prior mifepristone administration (Table 2). Table 3 shows the results of the uni- and multivariate regression analyses to determine the significant influencing factors on induction time. Inductions in which dinoprostone was administered showed significantly longer induction times. In contrast, the use of mifepristone in combination with a previous history of delivery without Caesarean section led to a significant reduction in the induction time.

Significant influencing parameters on delivery within 12 hours were low gestational age, a history of delivery (deliveries) without previous Caesarean section and prior mifepristone administration (Table 4).

**Discussion**

In the present study, we were able to show that the time interval between induction and delivery in medical abortions can be significantly reduced by the combined use of mifepristone and prostaglandin derivatives. Irrespective of the choice of prostaglandin, a reduction in the induction time by over 10 hours was recorded. In addition to mifepristone administration, early gestational age and higher parity without previous Caesarean section were significant influencing factors which led to a reduction in the induction time.

Our results are partially consistent with previous studies. Using 106 pregnancy terminations, Jannet et al. showed that induction times were significantly shorter in multipara when using a drug regimen similar to our induction regimen [11]. In our previous Table 1 Foetal abnormalities observed in the study group.

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneuploidy</td>
<td>142</td>
<td>42.7%</td>
</tr>
<tr>
<td>Heart defect</td>
<td>12</td>
<td>3.6%</td>
</tr>
<tr>
<td>Non-immunological hydrops fetalis</td>
<td>18</td>
<td>5.4%</td>
</tr>
<tr>
<td>Neural tube defect</td>
<td>25</td>
<td>7.5%</td>
</tr>
<tr>
<td>Neuromuscular or skeletal abnormality</td>
<td>38</td>
<td>11.4%</td>
</tr>
<tr>
<td>Renal abnormality</td>
<td>27</td>
<td>8.1%</td>
</tr>
<tr>
<td>CNS abnormality</td>
<td>29</td>
<td>8.7%</td>
</tr>
<tr>
<td>Other abnormality</td>
<td>42</td>
<td>12.6%</td>
</tr>
<tr>
<td>Total</td>
<td>333</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2 Induction time between initial prostaglandin administration and birth.

<table>
<thead>
<tr>
<th>Induction protocol</th>
<th>Number</th>
<th>Induction time</th>
<th>Mean value (standard deviation)</th>
<th>Median (25–75% quantile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misoprostol</td>
<td>242</td>
<td>19.7 (19.9)</td>
<td>14.2 (10.0–23.0)</td>
<td></td>
</tr>
<tr>
<td>▶️ With mifepristone</td>
<td>67</td>
<td>13.6 (10.3)*</td>
<td>10.7 (6.7–15.5)</td>
<td></td>
</tr>
<tr>
<td>▶️ Without mifepristone</td>
<td>175</td>
<td>22.0 (22.1)</td>
<td>16.0 (11.0–30.0)</td>
<td></td>
</tr>
<tr>
<td>Gemeprost</td>
<td>66</td>
<td>22.1 (17.4)</td>
<td>17.7 (11.0–30.0)</td>
<td></td>
</tr>
<tr>
<td>▶️ With mifepristone</td>
<td>8</td>
<td>11.4 (6.5)*</td>
<td>10.1 (6.0–15.0)</td>
<td></td>
</tr>
<tr>
<td>▶️ Without mifepristone</td>
<td>58</td>
<td>23.6 (17.9)</td>
<td>19.9 (11.0–30.0)</td>
<td></td>
</tr>
<tr>
<td>Dinoprostone</td>
<td>25</td>
<td>25.5 (31.1)</td>
<td>49.0 (32.0–69.0)</td>
<td></td>
</tr>
<tr>
<td>▶️ With mifepristone</td>
<td>6</td>
<td>37.6 (11.3)*</td>
<td>39.1 (28.3–48.1)</td>
<td></td>
</tr>
<tr>
<td>▶️ Without mifepristone</td>
<td>19</td>
<td>61.1 (33.4)</td>
<td>61.3 (32.0–71.3)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>333</td>
<td>22.4 (22.4)</td>
<td>16.0 (10.0–28.0)</td>
<td></td>
</tr>
</tbody>
</table>

Difference between induction with misoprostol with mifepristone vs. without mifepristone t-test p < 0.001
Difference between induction with gemeprost with mifepristone vs. without mifepristone t-test p = 0.001
Difference between induction with dinoprostone with mifepristone vs. without mifepristone t-test p = 0.015
and routes of administration which were included in this meta-

analysis. Concerning the route of administration of misoprostol, Akoury et al. observed a significant advantage for vaginal admin-

istration with regard to induction time. In a controlled-random-
ised study using 400 µg of misoprostol, they recorded an average

induction time of 30.5 (± 14.4) hours with oral and 18.3 (± 8.2)
hours with vaginal administration [16]. The vaginal administra-
tion of misoprostol at three-hourly intervals appears to be the

most effective option with an acceptable side effect profile. The

most frequently described side effect in this study was transient
diarrhoea. Our chosen dosage of 400 µg combined oral-vaginal
administration every 4 to 6 hours starting 24

hours after mife-

pristone administration corresponds with the spectrum of

epristone administration [8]. Due to conflicting results from other
study groups, this aspect must be considered as not yet definitely
resolved [12].

The shortest induction times were observed with the combined
use of mifepristone with gemeprost or misoprostol. The combi-
nation of mifepristone and misoprostol has been licensed in
France since 1988 [13]. The superiority of this combination over
regimens which use dinoprostone or gemeprost had been con-

confirmed in several studies, some randomised [14, 15]. In a current
Cochrane analysis, the use of misoprostol as a single agent was
confirmed to be an effective method; however its combination
with mifepristone appeared to significantly increase its effective-
ness [7]. No mandatory guideline can currently be derived from
the large number of randomised studies on dose, dosage interval
and routes of administration which were included in this meta-

Table 4  Uni- and multivariate logistic regression for predicting a delivery within 12 hours of the initial prostaglandin dose.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Delivery within 12 hours of first induction</th>
<th>Univariate logistic regression</th>
<th>p</th>
<th>Multivariate logistic regression</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>1.049 (1.009–1.090)</td>
<td>0.017</td>
<td>1.009 (0.962–1.057)</td>
<td>0.717</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>0.955 (0.906–1.007)</td>
<td>0.086</td>
<td>0.952 (0.935–1.000)</td>
<td>0.177</td>
<td></td>
</tr>
<tr>
<td>Gestational age (weeks of pregnancy)</td>
<td>0.885 (0.830–0.943)</td>
<td>&lt;0.001</td>
<td>0.868 (0.824–0.952)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Gravidity (n)</td>
<td>1.340 (1.123–1.599)</td>
<td>0.001</td>
<td>0.961 (0.707–1.305)</td>
<td>0.797</td>
<td></td>
</tr>
<tr>
<td>Parity (n)</td>
<td>1.561 (1.216–2.005)</td>
<td>&lt;0.001</td>
<td>1.314 (0.896–1.928)</td>
<td>0.162</td>
<td></td>
</tr>
</tbody>
</table>

Table 3  Uni- and multivariate regression analysis to determine the significant influencing factors on the induction time between initial prostaglandin administra-
tion and birth.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Induction time</th>
<th>Univariate regression</th>
<th>p</th>
<th>Multivariate regression</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>−0.097 (−0.508–0.313)</td>
<td>0.641</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>0.261 (0.275–0.797)</td>
<td>0.339</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational age (weeks of pregnancy)</td>
<td>0.918 (0.318–1.519)</td>
<td>0.003</td>
<td>0.386 (−0.162–0.935)</td>
<td>0.167</td>
<td></td>
</tr>
<tr>
<td>Gravidity (n)</td>
<td>−1.184 (−3.059–0.690)</td>
<td>0.215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity (n)</td>
<td>−1.336 (−3.908–1.236)</td>
<td>0.308</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Obstetrics medical history

- First-time mother
- Previous C-section
- Previous delivery (deliveries) without C-section

Mifepristone prior to induction

- Yes
- No

Drug regimen

- Mifepristone
- Misoprostol
- Gemeprost
- Dinoprostone

and delivery was only 1–2 hours shorter when mifepristone was used 12–24 hours before compared to a 36–48 hours interval [19]. Therefore, in a clinical setting, the start of prostaglandin administration within 24 hours of mifepristone administration appears to be most favourable, as the total duration of the abortion is effectively reduced and the variance of the possible abortion duration is limited to the greatest extent.

**Summary**

In this study, we were able to show that mifepristone followed by misoprostol or gemeprost 24 to 48 hours later led to the most rapid abortions in the 2nd and 3rd trimesters. In addition to the preliminary administration of mifepristone, gestational age and parity are significant influencing factors on the duration of induction.

**Conflict of Interest**

None.

**References**