

Immediate curettage versus conservative management following medically induced second-trimester abortion: a retrospective cohort study comparing maternal outcomes

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Abstract

Purpose: To evaluate maternal outcomes following immediate curettage versus conservative management after fetal expulsion in medically induced second-trimester abortion.

Methods: We conducted a retrospective cohort study of patients who underwent medically induced abortion between 14 and 28 weeks of gestation at a single tertiary center from 2014 to 2023. Patients were categorized according to post-expulsion management as immediate curettage or conservative management. The primary outcome was the rate of retained products of conception (RPOC). Secondary outcomes included short- and long-term complications such as infection, bleeding, infertility, and adverse obstetric outcomes.

Results: A total of 240 patients were included, 142 (59.2%) underwent immediate curettage, and 98 (40.8%) received conservative management. The rate of suspected RPOC on ultrasound was higher in the intervention group compared to conservative management (16.9% vs. 5.1%, $p=0.006$). However, hysteroscopic confirmation of RPOC did not significantly differ between groups. Immediate curettage was associated with higher rates of significant bleeding during hospitalization (14.8% vs. 3%, $p=0.003$), yet no significant differences were observed in short-term infections, infertility, recurrent miscarriage, or long-term obstetric outcomes. Multivariable analysis demonstrated that intervention following second-trimester medical abortion was not independently associated with RPOC after adjusting for maternal age, previous abortions, gestational age, abortion indication, and medical protocol type. Only maternal age was significantly associated with RPOC (aOR 1.2, 95% CI 1.1–1.5, $p=0.01$). No significant association was found between immediate intervention and short- or long-term maternal complication rates.

Conclusion: In this retrospective cohort, immediate curettage following medically induced second-trimester abortion was not independently associated with increased rates of pathologically confirmed RPOC or higher rates of short- or long-term maternal complications compared with conservative management. However, these findings should be interpreted with caution given the non-randomized design and potential baseline differences between groups. Further prospective studies are required to confirm these findings.

Introduction

Second-trimester abortion, defined as the termination of pregnancy between 14 and 28 weeks of gestation, is a critical component of comprehensive reproductive healthcare [1]. According to the CDC, in 2021, 625,978 abortions were reported in the US. 93.5% of the abortions were done before 13 weeks of gestation. Only 8.7% of the abortions were made after week 13 during 14–20 weeks, 5.7% were performed, and from week 21, only 0.9% were performed.[2]

Abortion treatment can be classified into surgical and medical approaches. Surgical procedures were more common, accounting for 6.4% of abortions after 13 weeks, while only 3% were medically induced

[2, 3]. The surgical approach typically involves dilation and evacuation (D&E) as the preferred method from 14 to 26 weeks [4, 5]. The medical approach relies on combining mifepristone and misoprostol [6]. This combination shortens time to fetal expulsion and increases complete abortion rates compared to misoprostol alone [7, 8].

There is currently no standardized protocol for managing patients immediately following a second-trimester medical abortion. Surgical intervention practices vary across institutions [9, 10]. Common indications for surgical intervention include failure to expel the placenta and significant vaginal bleeding [11]. Sonographic criteria for diagnosing retained products of conception (RPOC) after abortion vary widely, with endometrial thickness cutoffs ranging from 5 mm to over 30 mm; however, 15 mm is frequently adopted [12]. Most data pertain to first-trimester abortions. Surgical intervention is indicated in 7% of cases for retained placenta, 0.7% for retained products, and 0.2% for heavy bleeding [13]. In patients with suspected RPOC but no significant haemorrhage, the choice between immediate curettage and expectant management should weigh short- and long-term outcomes, including uterine integrity and future fertility [14].

Complications of curettage after medically induced second-trimester abortion include early issues such as infection, perforation, and rarely uterine rupture [7, 15], and late complications include retained product of conception and infertility. [3, 6, 7, 16]. Risk of RPOC increases with earlier gestational weeks [17]. Conservative management has higher RPOC risk than surgical abortion, increasing infection and need for intervention [18]. RPOC can cause secondary infertility due to intrauterine adhesions (Asherman syndrome) [18, 19], imposing burdens on patients and healthcare systems due to hospitalizations and long-term reproductive consequences [20–22].

The optimal management immediately after expulsion remains unclear [23], leaving a significant gap in evidence-based guidance. This study aimed to assess maternal complications after second-trimester medical abortion by comparing patients who underwent immediate curettage following fetal expulsion with those managed conservatively.

Methods

Study design and setting

This was a single-center retrospective cohort study conducted at a tertiary university-affiliated medical center between January 1, 2014, and January 31, 2023, and it is reported in accordance with STROBE guidelines.

Study population

This retrospective cohort study included all pregnant patients aged 18–45 years who were admitted for medically induced second-trimester abortion between 14 + 0/7 and 28 + 0/7 weeks of gestation during the study period. Only medically induced abortions using a misoprostol-only regimen or a combined

mifepristone–misoprostol regimen were eligible, and terminations were performed for fetal malformations, genetic abnormalities, maternal medical indications, or confirmed intrauterine fetal death or pregnancy loss.

Patients were excluded if they underwent surgical termination (dilation and evacuation), had multiple gestations, were younger than 18 or older than 45 years, were admitted with incomplete or septic abortion, received induction with prostaglandin E2 or other non-standard regimens, had contraindications to vaginal delivery, or presented with hemodynamic instability requiring urgent uterine evacuation.

The patients were classified into two management groups according to post-expulsion management: (1) an immediate curettage group, defined as patients who underwent uterine aspiration and curettage immediately after fetal expulsion; and (2) a conservative management group, defined as patients who did not undergo immediate uterine evacuation after fetal expulsion.

Outcomes and follow-up

The primary outcome was the rate of retained products of conception (RPOC) at the end of follow-up. Secondary outcomes included short-term complications (fever > 38°C within two weeks, significant bleeding defined as a hemoglobin decrease ≥ 2 g/dL, hemoglobin < 7 g/dL at discharge, or need for blood transfusion, and infection within one month) and long-term complications (infertility, recurrent miscarriage, and adverse obstetric outcomes in subsequent pregnancies such as ectopic pregnancy, preterm birth, premature rupture of membranes, intrauterine growth restriction, placental complications, postpartum hemorrhage, and need for manual uterine exploration). Follow-up was performed up to eight weeks and included outpatient ultrasound assessment; cases with suspected RPOC on ultrasound were referred for hysteroscopy and pathological confirmation when indicated.

Study protocol

All patients included in this study either had a confirmed diagnosis of pregnancy loss or underwent pregnancy termination following approval by the institutional Pregnancy Termination Committee. All patients were hospitalized for the procedure. Gestational age (GA) was determined based on a first-trimester transvaginal ultrasound. For patients at GA of 22 + 0/7 weeks or later, or when the estimated fetal weight exceeded 500 g, feticide was achieved via intra-amniotic injection of digoxin or direct administration of potassium chloride into the fetal heart.

For patients treated between 2014 and 2018, an initial 400 mcg buccal dose of misoprostol was administered. Additional buccal doses of 400 mcg misoprostol were given every four hours until fetal expulsion, with a maximum of five doses per cycle. For patients with a history of cesarean delivery, misoprostol was administered at six-hour intervals. Based on evidence supporting the efficacy of mifepristone in second-trimester abortions, institutional protocol was revised in 2018. Mifepristone was

incorporated as a pretreatment with a 200 mg oral dose. Approximately 24 hours later, the first dose of misoprostol (800 mcg buccally) was administered, followed by subsequent doses of 400 mcg buccally every 4–6 hours until fetal expulsion.

Following fetal expulsion, further management was guided by departmental criteria based on visual inspection and bedside ultrasound. Ultrasound evaluation included measurement of endometrial thickness in the sagittal plane. Immediate curettage (ultrasound-guided vacuum aspiration) was performed when at least one of the following criteria was present: (1) endometrial thickness > 15 mm; (2) failure of placental expulsion within 30 minutes; or (3) clinically significant vaginal bleeding, defined as active bleeding with hemodynamic concern or requiring urgent intervention as judged by the attending obstetrician. In the absence of these findings, patients were managed conservatively. These criteria were used throughout the study period, and decisions were made by the attending physician on duty; patient preference did not influence management in this acute inpatient setting.

Follow-up was performed according to the protocol (see “Outcomes and follow-up”); patients with suspected RPOC underwent outpatient ultrasound and hysteroscopy when indicated.

Data

Data were collected from electronic medical records, including demographics, obstetric history (gravidity, parity, prior cesarean, prior abortions), gestational age, induction protocol, endometrial thickness after expulsion, hemoglobin at admission and discharge, length of hospitalization, ultrasound evidence of RPOC, hysteroscopic/pathologic confirmation, short-term complications (bleeding, infection), and subsequent obstetric outcomes. Follow-up of medical records was conducted for each patient until July 2023 or until loss to follow-up.

Ethics

This study was performed in line with the principles of the Declaration of Helsinki. All methods were carried out in accordance with relevant guidelines and regulations. Protocol was approved by Meir Medical Center Human Investigation Committee number #0027-22-MMC. Due to the study's retrospective nature, the Meir Medical Center Human Investigation Committee has waived the need for an informed consent statement. All patient data were fully anonymized before extraction and analysis.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics, version 31 (IBM Corp., Armonk, NY, USA). The sample size was calculated using the WINepi software, which was used to estimate the percentage of patients expected to retain residual tissue in the uterine cavity within each study group. The overall rate of retained products following medical abortion is approximately 10% across all treatment approaches. We assumed that in patients managed conservatively, the retention rate would be

15%, whereas in those undergoing surgical intervention, the postoperative retention rate would be 5%. A Z-test for proportion comparison was performed to achieve a significance level of 5% and a power of 80%. Given a 1:1 ratio between the groups, a sample size of 141 patients per group was required to detect a difference of at least 10% in residual tissue rates.

Statistical analyses included descriptive statistics to differentiate characteristics. Quantitative variables were described using mean and standard deviation, while categorical variables were presented as frequencies and percentages.

Univariate analysis: The association between the dependent variable and each independent variable was examined separately. Relationships with quantitative variables were assessed using an independent sample T-test, while categorical variables were analyzed using a chi-square test.

Multivariable model construction to predict the incidence of retained products using logistic regression. The model included all variables that were statistically significant in the univariate analysis or were recognized in the literature as predictors of retained products, even if they were not significant in this study. The logistic regression model used in this study was based on Firth's Bias-Reduced Logistic Regression, a method developed for situations where events are rare or sample sizes are small. This approach reduces bias in coefficient estimates, provides finite and stable estimates, and generates more reliable confidence intervals compared to conventional logistic regression, especially in cases with a low number of events, as observed in our study.

Results

The study included 240 patients who underwent medical abortion during the second trimester who met the inclusion criteria. Of these, 142 (59.2%) underwent immediate curettage following fetal expulsion (Intervention group), while 98 (40.8%) received conservative management (Conservative management group).

Table 1 presents the baseline differences between study groups. Several statistically significant variations were observed. Patients in the Intervention group were older on average than those in the Conservative management group (33.4 ± 5.7 vs. 31.1 ± 5.9 , respectively; $p = 0.004$) and had a higher number of previous abortions (0.9 ± 1.4 vs. 0.7 ± 1.3 , respectively; $p = 0.02$). The Conservative management group had a significantly higher gestational age at the time of abortion (20.6 ± 2.7 vs. 19.1 ± 2.7 , respectively, $p < 0.001$) and by ultrasound estimation (20.3 ± 3.2 vs. 18.4 ± 3.1 , respectively, $p < 0.001$). No significant differences were found in other baseline characteristics, including demographics, medical history, laboratory data, or prior surgical procedures.

Table 1
Baseline Characteristics of Women in Conservative and Interventional Management Groups

Characteristic	Conservative Management (n = 98)	Interventional Management (n = 142)	P-Value
Age (years)	31.1 ± 5.9	33.4 ± 5.7	0.004
Body Mass Index (kg/m ²)	25.7 ± 5.5	25.7 ± 5.5	0.9
Comorbidities	17 (17.3%)	21 (14.8%)	0.8
Previous surgeries:			
- Hysteroscopy	5 (5.1%)	15 (10.6%)	0.13
- Myomectomy	0 (0.0%)	1 (0.7%)	0.9
- Curettage procedures (mean ± SD)	0.3 ± 0.7	0.3 ± 0.6	0.3
Previous miscarriages (mean ± SD)	0.7 ± 1.3	0.9 ± 1.4	0.02
Previous ectopic pregnancies	2 (2.0%)	2 (1.4%)	0.9
Previous cesarean sections	15 (15.3%)	16 (11.3%)	0.4
Gestational age at termination (weeks ± days)	20 + 6 ± 2.7	19 + 1 ± 2.7	< 0.001
Gestational age on ultrasound (weeks ± days)	20 + 3 ± 3.2	18 + 4 ± 3.1	< 0.001
Spontaneous pregnancies	86 (87.7%)	121 (85.2%)	0.7
Laboratory results at admission:			
- Hemoglobin (g/dL)	11.6 ± 1.2	11.8 ± 1.1	0.2
- White blood cell count (K/μL)	10.2 ± 3.5	9.4 ± 2.8	0.11
Continuous variables are presented as mean ± standard deviation (SD).			
Categorical variables are presented as number of cases (percentage).			
Gestational age is reported in weeks and days (e.g., 20 + 6 = 20 weeks and 6 days).			

Table 2 presents the characteristics of the groups regarding the termination management. In both groups, the most common indication for termination of pregnancy was elective termination. However, in the conservative management group, the rate of patients undergoing elective termination was significantly higher than in the interventional group (64.3% vs. 47.9%, respectively; p = 0.01). The rate of patients undergoing termination due to spontaneous abortion was significantly higher in the interventional group compared to the conservative group (32.4% vs. 16.3%, respectively; p = 0.01).

Table 2

Treatment protocol data for women undergoing second-trimester medical termination of pregnancy

Variable	Conservative Management(n = 98)	Interventional Management(n = 142)	P-Value
Indication for Termination			
Desired pregnancy termination	63 (64.3%)	68 (47.9%)	0.01
Spontaneous abortion	16 (16.3%)	46 (32.4%)	
Premature rupture of membranes	16 (16.3%)	28 (19.7%)	
Protocol			
Mifepristone-misoprostol	29 (29.6%)	77 (54.2%)	< 0.001
Misoprostol only	67 (68.4%)	65 (45.8%)	
Misoprostol doses (mean ± SD)	3.0 ± 1.6	2.7 ± 1.5	0.13
Fetal Heart Stopping (Feticide)			
None	59 (60.2%)	123 (86.6%)	< 0.001
Digoxin	25 (25.5%)	15 (10.6%)	
Potassium chloride	14 (14.3%)	4 (2.8%)	
Epidural Analgesia	54 (55.1%)	77 (54.2%)	> 0.9
Time from Misoprostol to Termination (hours)	14.0 ± 10.3	14.0 ± 10.6	0.8
Lab Results at Discharge			
Hemoglobin (g/dl)	11.1 ± 1.3	10.5 ± 1.4	0.007
White blood cells (K/μL)	10.9 ± 4.0	9.9 ± 3.2	0.2
Endometrial thickness (mm)	12.4 ± 6.7	10.6 ± 5.5	0.08
Length of Hospital Stay (days)	3.1 ± 1.4	3.3 ± 2.3	0.15
Continuous variables are presented as mean ± standard deviation (SD).			
Categorical variables are presented as number of cases (percentage).			

The interventional group had a higher proportion of patients treated with a combined protocol of mifepristone and misoprostol (54.2% vs. 29.6%, respectively; $p < 0.001$), whereas the misoprostol-only

protocol was more common in the conservative management group (68.4% vs. 45.8%, respectively; $p < 0.001$). Additionally, the preliminary step of inducing fetal demise using digoxin or potassium chloride was significantly less frequent in the interventional group compared to the conservative management group (60.2% vs. 86.6%, respectively; $p < 0.001$). Hemoglobin levels at discharge were lower in the interventional group compared to the conservative group (10.5 ± 1.4 vs. 11.1 ± 1.3 , respectively; $p = 0.007$). There was no statistically significant difference between the groups in the number of misoprostol doses required, duration of hospitalization, or the time from induction (first dose of misoprostol) to fetal expulsion.

Table 3 presents the short- and long-term maternal outcomes. Twenty-nine patients in the cohort had a RPOC on ultrasound. The rate of suspected RPOC on ultrasound was higher in the intervention group compared to the conservative management group (16.9% vs. 5.1%, respectively, $p = 0.006$). All patients with suspected RPOC on ultrasound underwent diagnostic hysteroscopy to confirm or refute the presence of retained tissue in the uterine cavity. Among these patients, retained tissue was pathologically confirmed in five cases. Four out of 24 who underwent hysteroscopy in the intervention group and one out of five in the conservative group. There was no statistically significant difference between the two groups in the proportion of RPOC confirmed by pathology following hysteroscopy.

Table 3
Short-term Outcomes and Subsequent Pregnancies Following Conservative and Interventional Management

Variable	Conservative Management (n = 98)	Interventional Management (n = 142)	P-Value
Retained placenta signs on ultrasound	5 (5.1%)	24 (16.9%)	0.006
Retained placenta confirmed by pathology (hysteroscopy)	1 (1.0%)	4 (2.8%)	0.4
Infection (weighted ¹)	3 (3.0%)	4 (2.8%)	0.9
Excessive bleeding during hospitalization ²	3 (3.0%)	21 (14.8%)	0.003
Hemoglobin level at post-discharge follow-up (g/dL)	12.6 ± 1.5	12.1 ± 1.2	0.2
New diagnosis of infertility	1 (1.0%)	8 (5.6%)	0.2
Subsequent pregnancy achieved	68 (69.4%)	93 (65.4%)	0.5
Spontaneous conception in subsequent pregnancy (%) [*]	56/68 (82.3%)	75/93 (80.6%)	0.9
Time to subsequent pregnancy (months)	7.9 ± 7.6	8.6 ± 10.5	0.5
Continuous variables are presented as mean ± standard deviation, while categorical variables are shown as the number of cases (percentage).			
[*] N represents all women who conceived again following the procedure; n represents the number who achieved spontaneous conception in the subsequent pregnancy.			
¹ Infection is a composite outcome that includes any of the following within one month of the procedure: endometritis, pelvic inflammatory disease, urinary tract infection, or fever within two weeks of discharge.			
² Excessive bleeding is defined as a drop in hemoglobin > 2 g/dL, the need for a blood transfusion, or diagnosis of anemia.			

The rate of significant bleeding during hospitalization was higher in the intervention group compared to the conservative management group (14.8% vs. 3%, respectively; p = 0.003).

No significant differences were observed between the groups in short-term infections rates, subsequent diagnosis of infertility or miscarriage rates following the procedure. Out of all participants, 161 patients conceived again following the termination of pregnancy. The rate of achieving subsequent pregnancies did not differ significantly between the groups. Most patients conceived spontaneously, with no significant difference between the groups in the method of conception or in the time to achieve pregnancy.

Table 4 presents the long-term obstetric complications. No significant differences were found between the groups in subsequent pregnancies, including excessive bleeding during delivery and the need for manual placental removal. Similarly, no differences were observed in complications such as preterm birth, premature rupture of membranes, or placental pathologies, including retained placenta and placenta previa/marginalis.

Table 4
Long-Term Outcomes – Complications in Future Pregnancies of Women Following Second-Trimester Medical Termination

Variable	Conservative Management (n = 68)	Interventional Management (n = 93)	P-Value
Subsequent miscarriages	13 (19.1%)	17 (18.2%)	0.9
Subsequent ectopic pregnancy	1 (1.5%)	2 (2.1%)	0.9
Excessive bleeding/manual placental removal	1 (1.5%)	5 (5.4%)	0.2
Placental complications ¹	1 (1.5%)	7 (7.5%)	0.1
Preterm delivery	3 (4.4%)	5 (5.4%)	0.9
Continuous variables are presented as mean ± standard deviation (SD).			
Categorical variables are presented as number of cases (percentage).			
¹ Placental complications include pathologies such as intrauterine growth restriction, retained placenta, or abnormal placental implantation (e.g., placenta previa).			

A multivariable analysis was conducted using a logistic regression model to examine the association between either surgical intervention or conservative management and presence of RPOC. Surgical intervention at the end of the procedure was not identified as an independent factor influencing the presence of RPOC after adjusting for age, previous miscarriages, gestational age, the indication for termination, and treatment protocol (aOR 1.3 [95% CI 0.2–7.6], $p = 0.75$). Maternal age was identified as an independent factor associated with the presence of RPOC (aOR 1.2 [95% CI 1.1–1.5], $p = 0.01$) (Table 5).

Table 5

Logistic Regression Model for Pathology Residue in Hysteroscopy among Women Who Underwent Second-Trimester Medical Abortion with Surgical Intervention or Conservative Management After Fetal Expulsion

Outcome	Unadjusted Analysis		Adjusted Analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Pathology residue in hysteroscopy				
Surgical intervention (curettage)	2.2 (0.3, 14.6)	0.4	1.3 (0.2, 7.6)	0.75
Woman's age (years)	1.3 (1.1, 1.6)	0.01	1.2 (1.1, 1.5)	0.01
Previous abortions	4.4 (0.7, 28.6)	0.12	2.5 (0.5, 12.4)	0.25
Estimated gestational age (weeks)	1.1 (0.9, 1.5)	0.31	1.1 (0.8, 1.4)	0.64
Abortion indication	Control group		Intervention group	
Termination of desired pregnancy	0.2 (0.02, 4.6)	0.35	0.2 (0.04, 3.7)	0.27
Missed abortion	0.9 (0.1, 6.1)	0.94	1.3 (0.2, 8.1)	0.76
Premature rupture of membranes				
Protocol type (misoprostol only or mifepristone + misoprostol)	0.2 (0.03, 1.6)	0.14	0.4 (0.1, 2.3)	0.32

A second multivariable analysis using a logistic regression model was performed to assess the association between each of the outcomes investigated in the study and surgical intervention or conservative management. Surgical intervention was not found to be an independent factor influencing any of the maternal outcomes examined in the study, including infections, infertility, excessive bleeding, recurrent miscarriages, preterm births, or placental complications, after adjusting for the same variables (Table 6).

Table 6: Logistic Regression Model for Short- and Long-Term Outcomes among Women Who Underwent Second-Trimester Medical Abortion with Surgical Intervention or Conservative Management After Fetal Expulsion

Outcome	Unadjusted Analysis		Adjusted Analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Residue in pathology examined by hysteroscopy	2.2 (0.3, 14.6)	0.4	1.3 (0.2, 7.6)	0.75
Infection ¹	1.0 (0.2, 4.1)	0.99	2.1 (0.5, 8.4)	0.29
New diagnosis of infertility	4.0 (0.7, 23.3)	0.12	2.4 (0.5, 12.1)	0.3
Subsequent abortion	0.96 (0.4, 2.1)	0.91	0.8 (0.4, 1.9)	0.67
Preterm birth (<37 weeks)	1.2 (0.3, 4.7)	0.81	0.8 (0.2, 3.3)	0.77
Placental complications ²	4 (0.7, 23.5)	0.13	0.8 (0.2, 3.3)	0.1
Excessive bleeding/manual placental removal at delivery	2.8 (0.5, 17.7)	0.26	2.4 (0.5, 13)	0.3

¹ **Infection:** Composite complication including at least one of the following: endometritis, pelvic infection, urinary tract infection (within one month post-abortion), or fever (up to two weeks post-abortion).

² **Placental complications:** Pathologies or abnormalities in placental implantation associated with intrauterine growth restriction, retained placenta, or abnormal placental location (e.g., placenta previa).

Discussion

In cases of medical termination of pregnancy during the second trimester, the management strategy following fetal expulsion remains controversial. Currently, no standardized protocol provides clear guidelines for this process. [24] This study aimed to compare maternal outcomes following conservative versus surgical management for medical termination of pregnancy during the second trimester. There were no statistically significant differences between immediate surgical intervention and conservative management in terms of RPOC rate. No statistically significant differences were observed in short- and long-term maternal complications.

A higher rate of suspected RPOC on follow-up ultrasound was observed in the surgical intervention group. Despite this, most patients did not ultimately require hysteroscopic evaluation. Among those who did undergo hysteroscopy, there was no significant difference between the groups in the rate of pathologically confirmed RPOC. This discrepancy, where ultrasound suspicion was more common in the surgical group, may be explained by the initial difficulty in placental separation that led to the need for surgical intervention in the first place, thereby increasing the likelihood of residual tissue. Additionally, ultrasound findings following surgical evacuation may reflect procedural changes in the uterine cavity

[25], making direct comparison with ultrasounds in the conservatively managed group more difficult. Although ultrasound is a key diagnostic tool for predicting retained placenta after second-trimester abortion [26], studies have presented its limitations, particularly in detecting late residual tissue, where sensitivity is reduced [27]. Given the low complication rates of office hysteroscopy,[28] it may be reasonable to err on the side of caution and perform hysteroscopy when there is uncertainty about the uterine cavity's condition after termination [29]. Multivariate analysis revealed that maternal age was associated with the presence of retained products in hysteroscopy, consistent with prior research [30]. This could be due to reduced endometrial responsiveness to hormonal stimulation with advancing age [31]. The intervention group comprised women with older maternal age, more previous abortions, and earlier gestational age, all of which are recognized risk factors for abnormal placental implantation and incomplete separation and may account for the higher likelihood of retained products observed [32–34]. In this context, the higher rate of intervention in this group could be viewed not as a procedural bias but rather as a response to an inherently more challenging uterine environment. Interestingly, despite these unfavourable baseline characteristics, no increase in adverse outcomes was observed in the intervention group following multivariate regression, either in the short or long term.

Evaluation of both short- and long-term maternal outcomes in our study revealed no association between the post-expulsion management protocol and adverse events. After multivariable adjustment, immediate surgical intervention was not independently associated with short- or long-term maternal complications, including bleeding, infection, infertility, subsequent miscarriages, or obstetric complications in future pregnancies. To the best of our knowledge, existing literature does not include studies that have systematically evaluated short- and long-term complications associated with medical second-trimester abortion followed by immediate surgical intervention after fetal expulsion. Therefore, there is a paucity of comparative data in this specific context.

In contrast, previous studies have reported higher rates of complications associated with surgical management. Regarding long-term outcomes, particularly infertility, one study investigating intrauterine adhesions following RPOC found a higher risk of adhesion formation after dilation and curettage compared to hysteroscopic resection [20]. Nonetheless, it is important to note that, according to the literature, the association between the method of abortion and the development of intrauterine adhesions remains insufficiently established [35]. A possible explanation for the lack of increased risk of infertility is that the cervix remains dilated this point due to the effects of the pharmacologic abortion process, minimizing the need for mechanical dilation and thereby reducing the risk of cervical trauma. [36] Importantly, prompt intervention decreases the likelihood of infection or prolonged inflammation, both of which are known contributors to intrauterine adhesions and subsequent infertility.[37]

In terms of short-term outcomes, we found a higher incidence of significant bleeding and lower mean hemoglobin levels upon discharge in the surgical group. This aligns with the indication for surgical intervention, where heavy bleeding necessitates evacuation, likely driving the association rather than resulting from the procedure itself. A study comparing medically induced abortion in the first trimester to a surgical approach reported higher rates of short-term complications in the surgical group, although

greater blood loss was observed in the medical group. The discrepancy in bleeding rates between studies may be attributed to differences in study methodology. It is reasonable to assume that patients experiencing significant bleeding would have undergone prompt surgical evacuation, thereby influencing the outcome. Moreover, they compared women who were pre-assigned to either dilation and curettage or medical induction in the first trimester, a setting in which medical abortions are known to be associated with a longer period of bleeding, as demonstrated in prior research.[38].

In our study, the intervention group had a higher rate of prior abortions. It is plausible that previous surgical procedures may have compromised the endometrial integrity, thereby impairing normal placental separation and increasing the risk of requiring subsequent interventions.[17] In contrast, according to our study, curettage following second-trimester abortion appears reassuring, as it does not seem to increase short- or long-term risks.

Conservative management was more likely as gestational age advanced. This is expected since larger, later-gestation placentas are more likely to be expelled completely, reducing the need for surgical intervention. [17] Rasmussen et al. reported an increased utilization of curettage in earlier gestational weeks. [9]

The strengths of this study lie in its long follow-up period, which allows for the evaluation of both short- and long-term outcomes, including fertility and obstetric results. Moreover, despite the intervention group demonstrating known risk factors for adverse outcomes, no significant differences in short- or long-term maternal complications were observed. Furthermore, it employed a unified internal institutional protocol, ensuring consistency and reducing variability in clinical management decisions. To the best of our knowledge, this is an innovative study, as no previous research has examined management protocols immediately following medical termination in this context.

Limitations include the relatively small sample size, which may have hindered the detection of differences in RPOC rates between groups. The absence of a significant difference in the actual RPOC rate between the groups may be attributed to the failure to meet the predetermined sample size required to detect a 10% difference in RPOC rates. This shortfall in sample size resulted from the relatively small number of cases managed conservatively that met the study's inclusion criteria, despite the inclusion of all patients who underwent conservative management following medical abortion at the hospital during the study period. Additionally, the retrospective nature of data collection from medical records introduces potential bias due to incomplete or inconsistent documentation over the study period. Efforts were made to minimize this limitation by excluding patients with significant missing data. However, errors or biases cannot be completely ruled out. Another methodological limitation is the non-randomized design of the study. Since this was not a prospective randomized trial, group allocation was determined by clinical criteria such as endometrial thickness and visible placental remnants rather than by random assignment. This may introduce selection bias and limit the ability to fully account for differences in baseline clinical characteristics between groups, as patients undergoing immediate curettage may have represented a clinically higher-risk subgroup at baseline. In addition, although

multivariable adjustment was performed, the analysis was limited to the variables available in the dataset, and unmeasured factors related to the clinical decision-making process may have influenced the observed outcomes. An additional limitation of this study is that the diagnosis of RPOC initially relied on ultrasound findings, which may vary in clinical interpretation. Although hysteroscopic and pathological confirmation was performed when clinically indicated, this was not applied uniformly to all patients, which may affect the comparison between groups. Finally, the choice between immediate curettage and conservative management was guided primarily by internal institutional protocols and individual clinical judgment. This lack of worldwide uniform management criteria introduces potential variability in clinical practice, making it difficult to generalize the findings.

In conclusion, surgical intervention for uterine evacuation following second-trimester medical abortion was not associated with an increased rate of hysteroscopically confirmed RPOC or with higher rates of short- or long-term maternal complications. Future prospective studies are needed to confirm these findings and further clarify optimal management strategies. However, these findings should be interpreted with caution, given the non-randomized design and potential baseline differences between groups.

Declarations

Author contribution:

- IH: Conceptualization, project development, data analysis, writing – original draft
- AAH: Conceptualization, writing – review and editing
- NN: Data collection, data analysis, writing – review and editing
- SY: Data analysis
- YD: Writing – review and editing
- ZK: Project development, writing – review and editing
- RS: Project development, writing – review and editing
- YY: project development, data analysis, writing – review and editing.

All authors have reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Ethics declarations

Conflict of interest: This study was performed in line with the principles of the Declaration of Helsinki. The study was approved by the Meir Medical Center Human Investigation Committee (No. 0027-22-MMC). Due to the retrospective design and use of anonymized data, the requirement for informed consent was waived by the committee.

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Figures

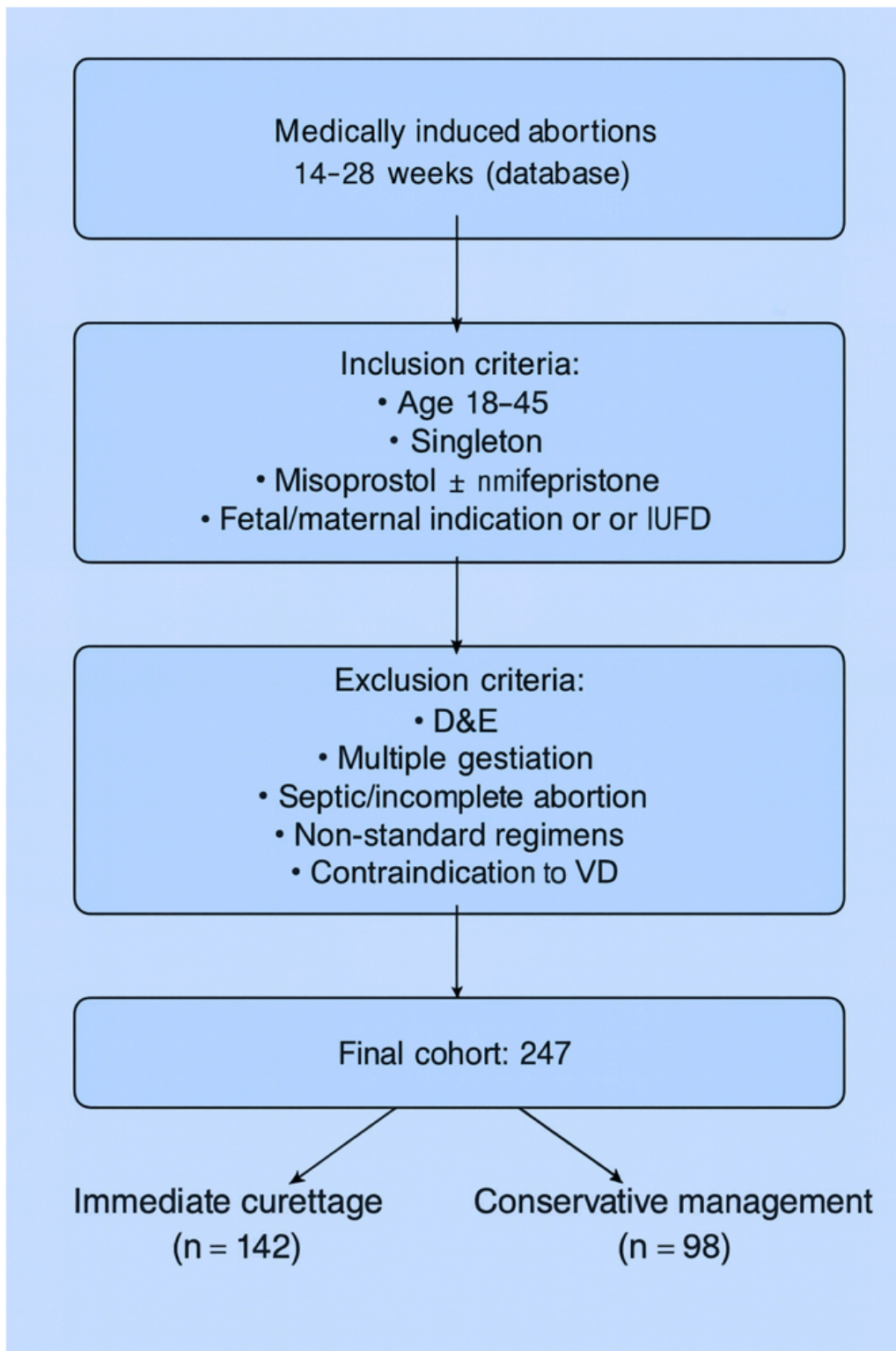


Figure 1

Patient selection and study flow