Midtrimester Dilation and Evacuation Versus Prostaglandin Induction: A Comparison of Composite Outcomes

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Midtrimester dilation and evacuation versus prostaglandin induction: a comparison of composite outcomes

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OBJECTIVE: The objective of the study was to determine the optimal procedure for midtrimester uterine evacuation.

STUDY DESIGN: This was a retrospective cohort study of women undergoing midtrimester uterine evacuation by prostaglandin induction or dilation and evacuation (D&E). Primary outcome was composite complication, defined as any of the following: infection, need for additional surgery, unexpected admission or readmission, serious maternal morbidity, and/or maternal death.

RESULTS: Two hundred twenty patients met inclusion criteria: 94 D&E and 126 induction. D&E was associated with less composite complications (15% vs 28%, $P = .02$), which persisted in adjusted analysis (adjusted odds ratio, 0.38; 95% confidence interval, 0.15–0.99; $P = .05$). Women in the induction group had higher rates of retained placenta requiring curettage (22% vs 2%, $P = .01$), whereas cervical injury was more common in the D&E group (5% vs 0%, $P = .01$). Median length of stay was significantly shorter in the D&E group (5.7 hours vs 28.4 hours, $P < .001$).

CONCLUSION: Midtrimester D&E is associated with fewer complications than prostaglandin induction.

Key words: dilation and evacuation, midtrimester uterine evacuation, prostaglandin induction, second-trimester abortion

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Midtrimester uterine evacuation is a process in which the contents of the uterus are removed during the second trimester of pregnancy. It can be performed electively, for fetal or pregnancy complications, or for maternal medical indications. Techniques for uterine evacuation include intrauterine prostaglandin instillation, prostaglandin induction, and dilation and evacuation (D&E). Older studies suggested that D&E is the safest of these methods.[1-4] Changes in maternal characteristics,[5-8] physician experience,[9-14] abortion techniques,[3,15] indications for prenatal screening for fetal anomalies,[16] and increasing number of abortions for fetal anomalies[17] over the last decade warrant reevaluation of the relative safety of these techniques.

Two contemporary studies have found that D&E continues to be safer than induction for second-trimester uterine evacuation.[18,19] Their retrospective/nonrandomized design, limited information regarding technique (such as use of ultrasound guidance), variation in clinical protocols between and within the 2 studies, and discrepancy in complication rates limits the certainty and generalizability of their conclusions.

The purpose of our study therefore was to compare the relative safety of ultrasound-guided D&E and prostaglandin induction for midtrimester uterine evacuation in a single institution with consistent clinical protocols.

Materials and Methods

We performed a retrospective cohort study of all women undergoing a planned midtrimester uterine evacuation procedure (13 0/7 weeks to 23 6/7 weeks) at our institution, Lehigh Valley Health Network (Allentown, PA) from January. 2005 to June 2010. This time period was chosen because a change in providers at the beginning of the time period resulted in a more standardized approach to offering and performing midtrimester uterine evacuation procedures.

Women undergoing D&E by an experienced provider under continuous ultrasound guidance were compared with those undergoing a prostaglandin induction during the study period. Patients were identified by procedure (Current Procedural Terminology) and diagnosis (*International Classification of Diseases*, ninth revision) codes. To identify women who may have been missed by our initial search criteria, we also reviewed Report of Induced Termination of Pregnancy forms (completion of these forms for each every elective termination are required by the Pennsylvania Department of Health) as well as delivery logs to identify any inductions for fetal demise.

Exclusion criteria included those in active labor and/or advanced cervical dilation during the initial evaluation, preexisting chorioamnionitis, and pregnancies outside the gestational age range of interest. Women in active labor and/or advanced cervical dilation were excluded because they did not require cervical ripening/dilation, an aspect of midtrimester termination that poses potential risk.

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Women with preexisting chorioamnionitis were excluded because the increased maternal risk required significant deviation from the clinical protocols of those undergoing planned procedures. Medical records were reviewed for maternal demographics (age, race/ethnicity, insurance type, parity), potential comorbidities (maternal medical conditions, previous uterine surgery, invasive testing), and procedure indications, details, and complications.

The primary outcome was occurrence of a composite complication, defined as any one of the following events: infection requiring the use of antibiotics for chorioamnionitis, endometritis or sepsis; blood transfusion; need for additional surgery (including cervical repair, uterine perforation repair, dilation and curettage [D&C], exploratory laparotomy or diagnostic laparoscopy); unexpected admission or readmission to the hospital for procedure-related complications within 6 weeks of the procedure; serious maternal morbidity; and/or maternal death. D&C included immediate and delayed procedures. Cervical repair included suturing of the cervix for laceration repair and/or to achieve hemostasis (in cases of bleeding without clear laceration such as for a puncture site from the tenaculum).

A composite complication was chosen as our primary outcome because we believed that it was clinically useful for counseling patients regarding overall procedural risk. We also evaluated serious complications (a subset of of composite complications) because these complications are associated with increased short- and long-term morbidity and, as such, are more likely to influence provider and patient decision making regarding choice of procedure. Serious complications were defined as any one of the following: blood transfusion, need for major additional surgery (laparotomy or laparoscopy), serious maternal morbidity, and/or maternal death. Our secondary outcome was length of stay.

Lehigh Valley Health Network serves as a referral center for patients with suspected fetal anomalies and/or pregnancy complications from the surrounding community and, as such, most women planning a second-trimester uterine evacuation procedure in our institution are seen by the Maternal-Fetal Medicine (MFM) team, which consists of perinatologists, genetic counselors, and nurse practitioners, all experienced in counseling patients regarding pregnancy options. Women in the second-trimester planning a uterine evacuation procedure are offered both D&E and induction. Fetuses with ultrasound findings suspicious for aneuploidy are encouraged to have invasive testing (amniocentesis or chorionic villus sampling [CVS]) as part of their evaluation. Women who choose to terminate without having had genetic testing are offered genetic testing at the time of cardioplegia or the evacuation procedure. In cases in which an autopsy may be helpful in making a diagnosis, patients are encouraged to consider induction. Some providers routinely recommend D&E at 13-14 weeks because of provider perception that D&E is easier than induction at earlier gestational ages.

In our institution, D&E is routinely performed as an outpatient procedure in the operating room under continuous ultrasound guidance by experienced providers. Cervical ripening with laminaria is used for all patients undergoing D&E greater than 16 weeks' gestation and for select patients prior to 16 weeks. Induction is performed as an inpatient procedure with vaginal misoprostol or dinoprostone. Misoprostol is used most often as the first-line agent. The regimen is at the discretion of the provider, typically misoprostol 200-400 μm every 3-4 hours per vagina (using 100 or 200 μg tablets) or dinoprostone suppository 20 mg per vagina every 3 hours. Oxytocin augmentation is occasionally used. The provider may switch agents if the patient does not appear to be responding to the initial agent, usually after multiple doses. In general, induction agents are administered until delivery of both the fetus and the placenta.

Cervical ripening prior to induction with laminaria or a Foley bulb prior to or on the day of induction is also occasionally performed at the discretion of the provider. All pregnancies 20 weeks or longer have injection of intracardiac potassium chloride (KCl) to induce fetal demise prior to the procedure, regardless of procedure type. This is performed 1-2 days prior to D&E and 0-2 days before induction.

Management of the third stage of labor is at the discretion of the provider. An attempt is made to deliver the placenta at the time of delivery (within 20-30 minutes). If the placenta does not deliver during that time, and there is no evidence of significant bleeding, women are generally allowed as many as 4-6 hours to deliver the placenta with continued administration of the induction agent during that time period. If the placenta does not deliver by the end of that time period or if there is significant bleeding at any time, a D&C is performed. Obstetrics and gynecology residents actively participate in the care of both the induction and the D&E patients under the direct supervision of attending physicians experienced in these procedures.

Student t test, χ^2, Mann Whitney U, and Fisher's exact test were used to compare characteristics of the women by uterine evacuation method. Risk ratios were calculated to identify predictors of composite complications. Multivariate logistic regression was used to calculate adjusted odds ratios, controlling for potential confounders as identified in unadjusted analysis and those that have been identified in the literature as being associated with complications. This study was reviewed and approved by the Lehigh Valley Health Network Institutional Review Board.

Results

Within the study period, 245 patients were identified as having undergone a midtrimester uterine evacuation; of these, 25 were subsequently excluded because they did not meet inclusion criteria (13 were not within the appropriate gestational age range, 8 had chorioamnionitis on presentation, 3 presented with advanced cervical dilation and prolapsing membranes, and 1 did not actually have an evacuation procedure), for a final cohort of 220 patients. Of those 220 patients, 94 had a midtrimester D&E and 126 had a midtrimester prostaglandin induction.

Baseline characteristics of both groups are outlined in Table 1. Women undergoing D&E were older, more likely to be

TABLE 1
Baseline maternal characteristics by procedure type

Characteristic	D&E (n = 94)	Induction (n = 126)	*P* value
Maternal age, y	32.8 ± 7.0	29.1 ± 6.0	< .001
Race or ethnicity			
White	74 (80%)	92 (73%)	
Hispanic	10 (11%)	25 (20%)	
African American	1 (1%)	6 (5%)	.05
Asian	4 (4%)	1 (1%)	
Other	4 (4%)	2 (2%)	
Private insurance	64 (68%)	68 (54%)	.03
Multiparous	55 (59%)	72 (57%)	.84
BMI, kg/m^2	27.8 ± 6.6	28.8 ± 6.7	.27
Any maternal comorbidity	39 (41%)	57 (45%)	.58
Previous cesarean delivery	13 (14%)	17 (13%)	.94
Previous LEEP/cone	6 (6%)	11 (9%)	.52
Cervical ripening prior to procedure	81 (86%)	38 (30%)	< .001
Any invasive diagnostic procedure[a]	61 (65%)	47 (37%)	< .001
CVS	27 (29%)	2 (1%)	< .001
Amniocentesis	35 (37%)	45 (36%)	.82
Induced fetal demise	25 (27%)	36 (29%)	.75
Median GA at procedure, wks	18 (13–23)	20 (15–23)	< .001
Gestational age category, wks			
13 0/7 to 15 6/7	33 (35%)	6 (5%)	
16 0/7 to 19 6/7	32 (34%)	48 (38%)	< .001
20 0/7 to 23 6/7	29 (31%)	72 (57%)	
Indication			
Chromosomal or genetic abnormality	43 (46%)	14 (11%)	< .001
Structural abnormality	25 (27%)	46 (37%)	.12
Fetal demise	22 (23%)	44 (35%)	.07
Maternal medical condition	2 (2%)	1 (1%)	.40
PPROM	1 (1%)	18 (14%)	.001
Other	1 (1%)	3 (2%)	.47

Data in mean ± SD or n (percentage). Any maternal comorbidity includes diabetes, hypertension, cardiac disease, respiratory disease, thrombophilia, anemia, depression/anxiety, and other.
BMI, body mass index; *CVS*, chorionic villus sampling; *D&E*, dilation and evacuation; *GA*, gestational age; *LEEP*, loop electrosurgical excision procedure; *PPROM*, preterm premature rupture of membranes.
[a] One patient had 2 invasive procedures (1 CVS and 1 amniocentesis).

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TABLE 2
Summary of induction regimens n (%)

Initial agent	
Misoprostol	117 (92)
Dinoprostone	7 (6)
Oxytocin	2 (2)
Need for second agent	10 (8)
Misoprostol, then dinoprostone	8 (6)
Dinoprostone, then misoprostol	1 (1)
Oxytocin, then misoprostol	1 (1)

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white and to have private insurance, and less likely to be Hispanic. Patients undergoing D&E had an earlier median gestational age at the time of the procedure, were more likely to have undergone invasive diagnostic testing, and were more likely to have had cervical ripening prior to the procedure. Patients less than 16 weeks were more likely to have a D&E and those over 20 weeks were more likely to have an induction.

Indications for the procedure in our cohort included fetal chromosomal/genetic abnormalities (26%), fetal structural abnormalities (32%), fetal demise (30%), maternal medical conditions (1%), preterm premature rupture of membranes (PPROM; 8%), and other (2%, includes 2 cases of oligohydramnios/anhydramnios, and 1 case each of growth restriction and viral infection).

Women undergoing D&E were more likely to have a fetal chromosomal or genetic abnormality as their primary indication for the procedure and less likely to have a PPROM (Table 1). Induction was most often initiated with misoprostol (92%) (Table 2). Eight percent of patients required a second agent because of failure to respond to the first agent. No patient in the induction group required a D&E for removal of the fetus. One patient in the D&E group went into early labor after placement of laminaria and, because no trained personnel were available at that time to perform a D&E, was augmented with misoprostol and delivered vaginally without complication.

Procedure outcomes and complications are summarized in Table 3. D&E was associated with fewer composite complications as compared with induction (15% vs 28%, $P = .02$), primarily because of more D&Cs for retained placenta in the induction group (22% vs 2%, $P < .001$).

All the D&Cs in the induction group were performed on the day of delivery for known or suspected retained placenta or placental fragments. The 2 D&Cs performed in the D&E group were

TABLE 3
Procedure outcomes and complications by procedure type[a]

Outcome	D&E (n = 94)	Induction (n = 126)	*P* value
Composite complication[b]	14 (15%)	35 (28%)	.02
Serious complication[c]	2 (2%)	3 (2%)	.55
Transfusion	1 (1%)	2 (2%)	.74
Chorioamnionitis/endometritis	4 (4%)	10 (8%)	.27
Additional (unplanned) surgery	8 (9%)	28 (22%)	.007
D&C	2 (2%)	28 (22%)	.001
Repair of cervix[d]	5 (5%)	0 (0%)	.01
Repair of uterine perforation	1 (1%)	0 (0%)	.25
Unexpected admission/readmission	9 (10%)	2 (2%)	
Infection	4 (4%)	1 (1%)	
Delayed dilation and curettage	2 (2%)	0 (0%)	
Laparotomy/bowel resection	1 (1%)	0 (0%)	.13
Labor from cervical ripening	1 (1%)	0 (0%)	
Observation for bleeding	1 (1%)	0 (0%)	
Pulmonary embolus	0 (0%)	1 (1%)	
Length of stay (median h)	5.4 (2.4–241.4)	28.1 (14.4–113.1)	< .001

Data are in n (percentage) or median (range). Delayed D&C occurred on a day other than the day of the procedure.
D&C, dilation and curettage; *D&E*, dilation and evacuation.

[a] Some patients had more than 1 complication; [b] Composite complication included any 1 of the following: infection requiring the use of antibiotics for chorioamnionitis, endometritis or sepsis, blood transfusion, need for additional surgery, unexpected admission or readmission to the hospital for procedure-related complications, serious maternal morbidity, and/or maternal death; [c] Serious complication included any one of the following: blood transfusion, need for major additional surgery (laparotomy or laparoscopy), serious maternal morbidity, and/or maternal death; [d] Included repair of cervix for any reason (bleeding, laceration).

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done at 1 and 4 weeks after the procedure for suspected retained products of conception; only 1 of these patients actually had evidence of retained products of conception on pathology. Cervical repair was required for 5 patients in the D&E group: 3 times for repair of a cervical laceration and twice to achieve hemostasis for bleeding at the tenaculum site.

There was no difference in serious complications, which were rare in both groups. Serious complications included 1 transfusion, and 1 uterine perforation/sigmoid bowel injury in the D&E group and 1 pulmonary embolism and 2 transfusions in the induction group. There were no maternal deaths. Median length of stay was significantly longer in the induction group (28.4 hours vs 5.7 hours, $P < .001$).

Unadjusted risk ratios were calculated to identify predictors of composite complications (Table 4). D&E and multiparity decreased the risk, and PPROM increased the risk of composite complications. Multivariate logistic regression was then performed to control for the potential confounders identified by unadjusted analysis, differences in baseline characteristics between the groups, and potential confounders previously identified in the literature. When controlling for gestational age at procedure, maternal age, race/ethnicity, parity, insurance type, cervical ripening, and indication, D&E remained associated with less composite complications than induction (adjusted odds ratio [AOR], 0.38; 95% confidence interval [CI], 0.15–0.99; $P = .05$). Because PPROM had the strongest association with morbidity and most of these patients (18 of 19) were in the induction group, we repeated the analysis excluding those patients with PPROM. Even when patients with PPROM were excluded, D&E remained associated with less composite complications when controlling for the same potential confounders (AOR, 0.34; 95% CI 0.12–0.95; $P = .04$).

Comment

In our study population, D&E under ultrasound guidance was associated with a 60% reduction in complications compared with prostaglandin induction for midtrimester uterine evacuation. This confirms the findings of both historical[1-4] and contemporary studies.[18,19] We chose a composite complication as our primary outcome because we felt that this information is clinically useful for counseling patients regarding overall procedural risks, and it compensates for the small cohort size relative to the expected frequency of complications.

The primary reason for this risk reduction in our cohort was an increased incidence of D&Cs for retained placenta in the induction group. Serious complications were rare in both groups. When only serious complications were considered (blood transfusion, need for major additional surgery, serious maternal morbidity, and/or maternal death), there was no difference between the 2 procedures, making either procedure a reasonable choice for midtrimester uterine evacuation.

Fifteen percent of women in our D&E group had complications; this is higher than reported by Bryant et al[18] (3%) and Autry et al[3] (5%) but similar to Edlow et al[19] (11%). The difference in our results primarily was due to a higher incidence of cervical repair and unexpected admissions/readmissions in our D&E group. Our percentage of cervical repair may have been higher than reported in these other studies because we included women who required suturing of the cervix for hemostasis (2 cases); if we had included only cases of true lacerations (3 cases), our D&E complications would have decreased to 13%. It is unclear why we had more unexpected admissions/readmissions after D&E, but this may have been because of the high percentage of women with medical comorbidities in our cohort (41%). In addition, our inclusion criteria were broader than Bryant et al, who excluded patients with spontaneous rupture of membranes and onset of labor before the evacuation procedure.[18] If we had also excluded these patients (3 cases), the proportion of

complications in the D&E group would have been 10% (9 of 91 cases).

Conversely, less infections morbidity and no failed inductions resulted in less complications (28%) in our induction group than reported by Edlow et al[19] and Autry et al[3] (44% and 45%, respectively). The most common complication in the induction group in our study was retained placenta requiring D&C (22%), which is consistent with previously reported statistics.

In our unadjusted analysis, only procedure type, parity, and PPROM were predictors of complications; this is consistent with the findings of other contemporary studies (Bryant, indication; Edlow, parity). We did not find an association with other factors that have been reported to influence the occurrence of complications, such as maternal age,[20] gestational age at procedure,[18,19] race,[18] fetal demise,[18,19] uterine scar,[3] or cervical ripening.[3] We opted to include all these factors in our adjusted analysis because they had previously been identified in the literature as confounders and because many of these characteristics were statistically different between our 2 procedure groups.

In our institution, we perform midtrimester uterine evacuations for women with fetal anomalies, fetal demise, or maternal medical conditions in which pregnancy could jeopardize the mother's health or make it unsafe to perform these procedures outside a hospital setting. As a regional hospital with a large prenatal diagnosis program, we see many patients with fetal anomalies, approximately half of whom choose to terminate their pregnancy.

Regardless of indication, all women are offered either procedure, although women without a known diagnosis are encouraged to consider induction so that an autopsy can be performed. In our experience, the decision to choose 1 procedure over the other is highly personal. Some patients wish to avoid labor, whereas others want to see and hold the fetus.

As compared with the induction group, women in the D&E group were older, earlier in gestation, more likely to be white, have private insurance, and to have had an invasive diagnostic procedure and more likely to have cervical ripening prior to their evacuation procedure. These differences may introduce selection bias and/or confounding, although they are more likely a result of the differences in indications for the procedures. For example, the lower gestational age in the D&E group most likely reflects both the earlier gestational age at time of diagnosis of a fetal abnormality and increased likelihood of a known diagnosis in the D&E group,[21] as evidenced by the increased rate of CVS and chromosomal/genetic abnormalities, as opposed to a reluctance of providers to perform D&E at later gestations.

In addition to safety, another clear advantage of D&E is the reduced length of stay because both help to decrease health care costs. In our institution, for example, the cost of a D&E is approximately two-thirds the cost of an induction. In the state of Pennsylvania, many insurance companies do not cover the cost of midtrimester uterine evacuation, regardless of the indication; some cover the procedure only when the mother's life is at risk. Difference in cost therefore may influence the patient's decision regarding procedure type.

Despite evidence that D&E is safer and more cost effective than induction,[22] access to providers experienced in this procedure may be limited in certain parts of the country.[9-13] Access may be even more limited in the future, given that many residency programs do not rou-

TABLE 4
Predictors of complications for midtrimester uterine evacuation

Variable	Unadjusted risk ratio (95% CI)	*P* value
D&E	0.54 (0.31–0.94)	.02
Maternal age ≥30 y	1.03 (0.63–1.70)	.90
White	1.27 (0.68–2.37)	.44
Hispanic	0.88 (0.43–1.80)	.72
Private insurance	0.89 (0.54–1.46)	.64
Multiparous	0.60 (0.36–0.98)	.04
BMI ≥30 kgm^2	0.99 (0.58–1.69)	.96
Any maternal comorbidity	1.05 (0.64–1.73)	.84
Previous cesarean delivery	0.72 (0.31–1.67)	.43
Previous LEEP	1.36 (0.62–2.96)	.46
Cervical ripening	0.69 (0.42–1.14)	.14
Any invasive diagnostic procedure	0.72 (0.43–1.18)	.19
Gestational age category, wks		
13 0/7 to 15 6/7	1.04 (0.55–1.97)	.89
16 0/7 to 19 6/7	1.02 (0.61–1.70)	.95
20 0/7 to 23 6/7	0.96 (0.58–1.58)	.87
Gestational age <20 wks	1.04 (0.63–1.71)	.87
Gestational age >20 wks	0.96 (0.58–1.58)	
Indication		
Induced fetal demise	0.93 (0.54–1.62)	.81
Chromosomal/genetic abnormality	0.64 (0.33–1.24)	.17
Structural abnormality	0.76 (0.43–1.34)	.33
PPROM	3.06 (1.90–4.94)	< .001

BMI, body mass index; *CI*, confidence interval; *D&E*, dilation and evacuation; *LEEP*, loop electrosurgical excision procedure; PPROM, preterm premature rupture of membranes.

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tinely train their residents to perform second-trimester D&E,[9-13] and providers are less likely to perform these in practice if they did not get adequate experience in residency.[14] State laws and institutional culture may also limit access to D&E or influence provider counseling. In our institution, for example, providers have the option to opt out of caring for patients undergoing pregnancy termination and are more likely to opt out of being involved with a D&E as compared with induction because they find D&E to be more psychologically stressful.

Because provider experience with D&E likely correlates strongly with complications, the results of our study may not be generalizable, although the threshold needed to achieve competence has not been defined. Experience is likely to have a larger impact on D&E than induction, given the technical differences in these procedures. As such, in cases in which experienced providers are not available, induction may be the safer procedure.

The strengths of our study include short study period (reducing variation in clinical management) and level of detail regarding indications and clinical protocols. The contemporary study period enabled us to evaluate complication rates associated with current practice trends, such as use of KCl induction of fetal demise and ultrasound guidance.[23,24] We choose to do fetal KCl injection prior to these procedures 20 weeks or longer to avoid the complex medicolegal issues and psychological stress to both patient and provider in the setting of a live-born periviable fetus.

Use of KCl has also been shown to decrease the time to delivery in midtrimester induction[24] and is believed by experienced providers, including the authors, to aid with ease of tissue removal at the time of midtrimester D&E. Some patients opt to have KCl before induction or D&E prior to 20 weeks to ensure that the fetus is not alive at the time of the termination.

Limitations of our study include its retrospective nature, which can introduce bias, such as information or selection bias. For example, baseline characteristics between groups were different, and there may have been factors influencing choice of procedure that were not accounted for in our analysis that may have placed more high-risk patients in the induction group. Given the significant psychological stress involved in these clinical situations, however, we feel that it would be difficult to perform a prospective randomized trial to answer this study question.

Additionally, our results may not be comparable with other institutions with providers less experienced in D&E, other populations, or other clinical protocols. For example, protocols that do not include routine KCl induction of fetal demise or ultrasound guidance may show different complication rates in both groups.

Finally, we chose a composite outcome, which included both major and minor complications because we believed this was most useful clinically, and we expected our sample size to lack the power to evaluate most individual complications, particularly serious complications (which are rare). For example, given the low incidence of transfusion observed in our cohort, we had only a 9% power to show a difference in this complication between groups (or would have needed 2319 in each group to show a difference with 80% power).

Summary

Our data suggest that midtrimester D&E under ultrasound guidance is safer and potentially more cost-effective than prostaglandin induction. Although there are many factors that may influence provider and patient preference, from a systems perspective, D&E may be preferable to prostaglandin induction for midtrimester uterine evacuation. ■

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