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Review article

Impact of previous caesarean section on outcomes of first and second trimester surgical abortion: A systematic review and meta-analysis

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ABSTRACT

Background: It is unclear whether previous caesarean section (CS) increases the risk of complications during surgical abortion.
Aims: To compare surgical abortion complication rates in women with a history of previous CS to those without previous CS.
Materials and methods: Four databases were systematically searched in July 2024. Primary studies in English reporting on surgical abortion complications in women with and without a history of previous CS were included. Overall complications and major complications were compared between women with and without previous CS using a random effects meta-analysis. Sub-analyses were performed in women with > 1 previous CS, and incidence of emergency hysterectomy. Certainty of evidence was assessed using GRADE.
Results: Ten retrospective cohort studies with 3123 women with and 14,514 without a previous CS were included in the meta-analysis. The overall incidence of major complications from surgical abortion was 0.9 %. Previous CS was associated with an increase in overall complications (OR = 2.00, CI 1.32–3.04, p = 0.001) and major complications (OR = 2.82, CI 1.83–4.36, p < 0.00001). Major complications included haemorrhage requiring transfusion, uterine perforation and unplanned laparoscopy/laparotomy, while minor complications included cervical laceration and the need for repeat evacuation. There were no cases of uterine rupture during pre-procedural cervical ripening. Hysterectomy was an exceptionally rare occurrence (0.05 %); low-quality evidence from seven studies showed an association between history of CS and need for emergency hysterectomy (OR = 8.73, CI = 1.83–41.61, p = 0.007). The quality of the evidence was judged to be very low to medium mainly due to risk of bias of the included studies.
Conclusion: While major surgical complications of surgical abortion are rare, women with a prior history of CS were more than twice as likely to experience a complication.

Introduction

Surgical abortion is a common and safe procedure, although it carries small risks (1–2 %) of retained products of conception (RPOC) and need for repeat evacuation, as well as uncommon risks (0.1–0.2 %) of more significant adverse outcomes such as uterine perforation, haemorrhage and need for abdominal surgery[1–3]. These risks increase with increasing gestation, and difficult dilation of the cervix is a known risk factor, which may be more commonly encountered in those without prior vaginal birth and those with previous CS[1,4]. Additionally, previous CS carries very small risks of encountering undiagnosed placenta accreta spectrum (PAS) or caesarean scar pregnancy (CSP) during

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surgical abortion[5].

The bulk of existing literature has focused on the safety of medical abortion and establishing the risk of uterine rupture during second trimester medical abortion for those with previous CS[5–7]. Outcomes of surgical abortion in this population have not been previously synthesized, which is crucial since individual studies on this topic are often underpowered to detect differences in uncommon adverse outcomes.

The increasing rate of CS, as well as the steadily low rate of vaginal birth after caesarean section (VBAC), has led to an increase in clients with a history of more than 1 previous CS presenting to abortion services [8,9]. Evidence indicates that the risk of uterine rupture is higher with medical abortion in individuals with multiple previous CS compared to those with only one previous CS[5]. This raises an important clinical question: is surgical abortion a safer alternative in this context? However, it remains unclear whether an increasing number of previous CS correlates with higher perioperative risks associated with surgical abortion.

The aim of this study was to synthesise the available evidence on the incidence of perioperative surgical complications during first and second trimester surgical abortion in women with previous caesarean section compared to those without.

Materials and methods

Protocol and registration

The Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guideline was followed for the design and report of this study [10]. This study was initially part of a scoping review, the protocol for which was prospectively registered with Open Science Framework (OSF. IO/AH79V). During data collection for the larger scoping review on abortion after previous caesarean section, a more specific research question was identified, and data were then used to conduct this meta-analysis.

Search strategy and study selection

The population, exposure, comparison and outcome (PECO) framework was followed to outline the search strategy and eligibility criteria [11]: (P) women who underwent a surgical abortion during the first or second trimester, (E) had a history of caesarean section, (C) compared to those without a history of caesarean section, (O) and reported surgical complications (e.g. haemorrhage, need for repeat evacuation, uterine perforation, uterine rupture, cervical laceration, hysterectomy, hospital transfer or unplanned admission to hospital).

The search strategy to identify relevant articles involved four databases (MEDLINE (Ovid), CINAHL, SCOPUS and EMBASE) from inception to July 2024. The medical subheadings and search terms, with the concepts of pregnancy termination, abortion, caesarean, and outcomes, were used to perform the search. More details on the search strategy are available in Supplementary Table 1. The relevant studies were exported to Covidence[12]. A backward snowballing approach was used to ensure no missing articles.

Two authors (ND and VG) independently screened articles and conflicts were resolved by the involvement of a third reviewer (CD).

Articles meeting inclusion criteria (Supplementary Table 2) were included. Human studies on surgical abortion outcomes during the first or the second trimester were included if they reported outcomes for participants with at least one previous CS. Studies that did not report surgical outcomes or adverse events, but only examined cervical ripening methods, were also excluded. Methods of surgical abortion included were manual vacuum aspiration (MVA), suction dilation and curettage (D&C) or dilation and evacuation (D&E); studies on medical abortion were excluded from the meta-analysis, as were studies involving only the management of miscarriage or intrauterine fetal death. Studies involving planned hysterotomy, gravid hysterectomy or management of known CSP or PAS were excluded. However, studies and case reports of women undergoing surgical abortion with undiagnosed CSP/PAS that became apparent during the procedure were included.

The search was limited to articles published in English; there were no date limitations. Primary analytical observational and interventional studies were included. Case reports, case series, cross-sectional studies and secondary sources of evidence including systematic reviews, opinions, book chapters, letters to the editor, protocols and guidelines were excluded.

Data extraction

The following data were extracted from the included studies: (a) study characteristics including first author's name, methodology, publication year, country of origin, study setting and sample size; (b) participant demographics including age, gestational age, parity, mode of prior deliveries, body mass index (BMI), (c) procedure information including method of surgical abortion, type of clinician performing procedure, cervical ripening method, specific techniques mentioned or intraoperative medications; (d) surgical outcomes including number of complications, type of complication (haemorrhage, blood transfusion, need for repeat evacuation, uterine perforation, uterine rupture, cervical laceration, hysterectomy, hospital transfer or unplanned admission to hospital).

Study risk of bias and quality of evidence assessment

Risk of bias was performed by two reviewers (ND and VG) using the Risk of Bias in Non-Randomized Studies – Exposure (ROBINS-E) tool for observational studies [13]. Conflicts were resolved by discussion or involvement of a third reviewer (CD).

The certainty of evidence assessment was performed using Grading of Recommendations Assessment, Development, and Evaluation (GRADE)[14]. Outcomes were judged as being 'high', 'moderate', 'low' or 'very low' quality of evidence. Two authors (ND and ZM) performed the quality of evidence assessment separately. Discrepancies were resolved by discussion or involvement of a third reviewer (CD).

Statistical analysis

The meta-analyses were performed in Review Manager (Revman) 5.4.1 using the Mantel-Haenszel random-effect analysis to calculate the pooled odd ratios (ORs) for each outcome. 95 % confidence intervals (CIs) were used to determine the precision of the findings[15]. The heterogeneity between studies was assessed by calculating I^2 (with the significance of < 0.1) and interpreted according to the Cochrane Handbook[16]. A sensitivity analysis was assessed for outcomes where there was a study which was heavily weighted or had a wide CIs. A funnel plot and Egger's regression-based test (with the significance of < 0.1) were applied using IBM SPSS v31 to determine the publication bias [17].

Definitions

First trimester is defined as less than 13 weeks gestation and second trimester 13 weeks to 28 weeks. However, two included studies[18,19] defined the second trimester as beginning at 12 + 0; these were included in the second trimester analysis as data were unable to be extracted separately. Major surgical complication was defined as any of the following: haemorrhage $\geq$ 500 ml, blood transfusion, need for balloon tamponade, hospitalisation, uterine perforation, need for laparotomy/laparoscopy, visceral injury, venous thromboembolism, disseminated intravascular coagulation, sepsis, hysterectomy, and death. Cervical laceration without haemorrhage, blood loss $<$ 500 ml, delivery outside the operating room, retained products of conception and need for repeat evacuation were considered minor complications. One study defined

blood loss > 250 ml as 'major complication' and it was not possible to separately extract data only for participants with ≥ 500 ml because they was reported as part of a pooled number of major complications[20]; for the purpose of the meta-analysis, these data were extracted and analysed as major complications.

Patient and public involvement

Patients and the public were not involved in the design or conduct of this systematic review.

Results

Study selection

The study selection process according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [21] is shown in Fig. 1. 7683 unique studies were identified and screened, and 237 underwent full text review. A further 17 articles were identified via hand searching the references of included articles, of which three were eligible for inclusion. The initial search was conducted for a larger scoping review conducted by the same authors[5], and eligibility criteria applied for inclusion into this meta-analysis. See Fig. 1 for a breakdown of reasons for exclusions.

One study was excluded due to insufficient data available in the manuscript, and the authors received no response to an email requesting further data[22]. This study examined blood loss at the time of uterine evacuation between 14–24 weeks, but notably 26.7 % of the participants had fetal demise. 31 of 161 women in this study had had prior CS, with no significant increase in haemorrhage ≥ 500 ml compared to women without prior CS on multivariate logistic regression analysis. Another study examining adjuvant misoprostol or mifepristone with osmotic dilators before D&E did report complications, but without data on outcomes for those with and without prior CS[23]. As no response was received to our request for additional data, this study was also excluded. Two studies were excluded because they included medical methods of termination and third-trimester terminations of pregnancy, and relevant data for first- and second-trimester surgical abortion could not be extracted separately[1,24].

Ten studies met the inclusion criteria and were included in the meta-analysis[8,18–20,25–30].

Characteristics of included studies

Table 1 and 2 summarise the characteristics of the ten included studies. The pooled sample size of participants was 17,637; a total of 3123 participants had a history of prior CS, and 14,514 had no prior CS. All were retrospective cohort studies; conducted in the United States of America (7 studies[18–20,25,26,28,29]), Israel (2 studies[8,30]) and the United Kingdom (1 study[27]). The mean age of participants ranged from 22.4[27] to 28.4[8] years old. One study only reported procedures performed in the first trimester [26], one reported on both first and second trimester procedures without separating these data[29], and the remaining eight studies reported second trimester surgical abortions [8,18–20,25,27,28,30]. Surgical abortion method was MVA[26], suction D&C[26,29], or D&E[8,18–20,25,27–30]. A variety of cervical ripening methods were used for second trimester D&Es, including laminaria[8,29,30], osmotic dilators[18,28], misoprostol in doses of 400-800mcg[20,26], or a combination of laminaria or osmotic dilators followed by misoprostol[19,25,27]. Settings included a tertiary hospital [8], non-tertiary hospitals[20,26,29,30] and freestanding abortion clinics/outpatient settings[18,19,25,27–29]. Five studies were judged to have 'low' risk of bias[8,19,20,27,28], three studies scored 'some' risk of bias[18,29,30], and two studies scored a 'high' risk of bias[25,26].

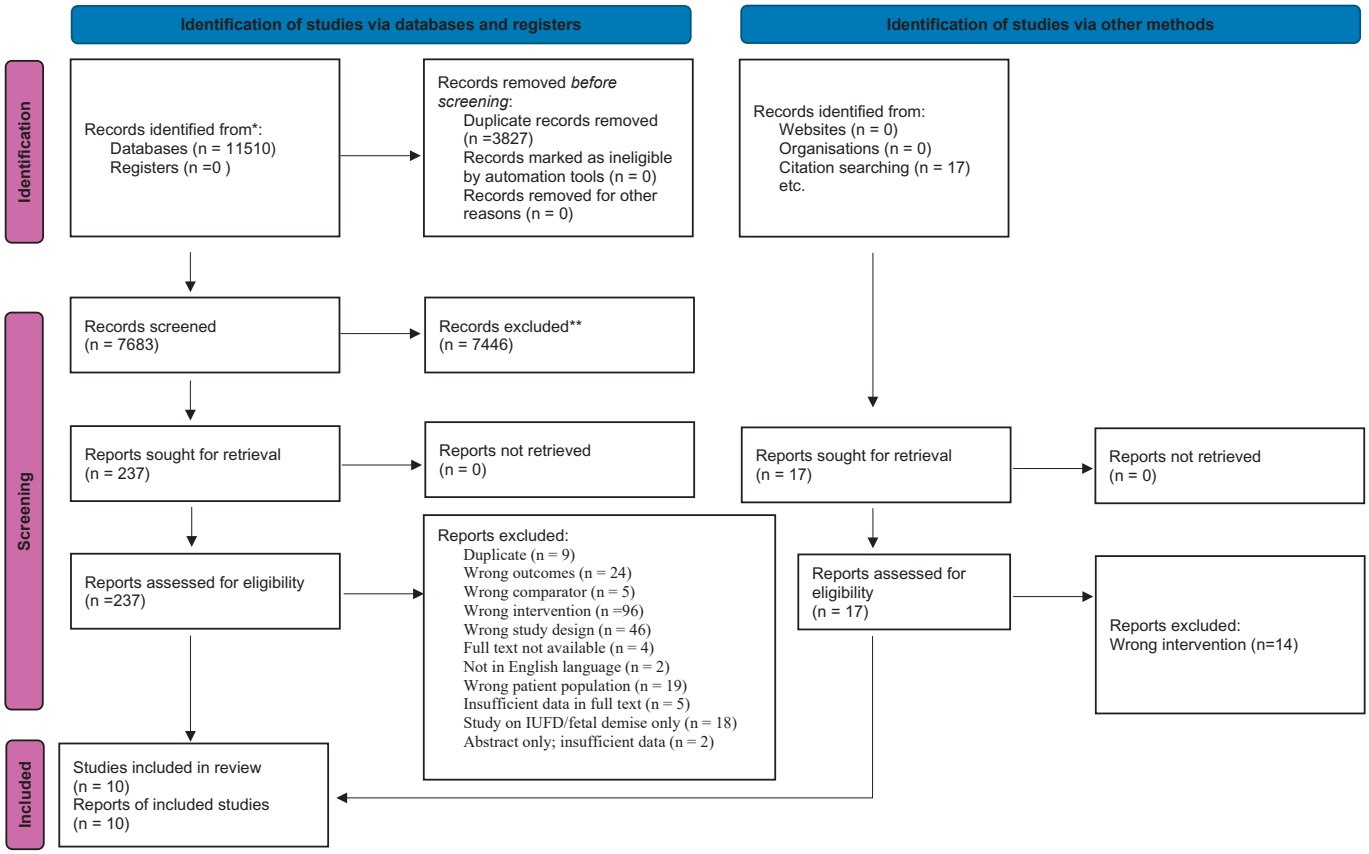

Fig. 1. Study selection process according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.

Table 1
Characteristics of included studies.

Author (ref)	Year	Country	Setting	Study design	Risk of bias	Abortion method	Proceduralist	Mean age (years)	Gestation range (weeks)	Mean BMI (Kg/m2)	Sample Size (n)		
											Overall	No Prior CS	Prior CS
Ben-Ami (8)	2009	Israel	Tertiary Hospital	Retrospective cohort	Low	D&E	Skilled physician	28.4	17– 24	23.6	636	545	91
Frick (25)	2010	USA	Outpatient	Retrospective cohort	High	D&E	Physicians, fellows and 3rd year residents	25.7	14 – 27	–	2973	2330	643
Guiahi (26)	2015	USA	Hospital/ day surgery	Retrospective cohort	High	MVA/ D&C	–	27.3	≤14	25.1	1960	1597	363
Lederle (28)	2015	USA	Outpatient	Retrospective cohort	Low	D&E	Physicians, fellows and 3rd year residents	26.6	14—24	27.6	4520	3542	978
Lohr (27)	2018	UK	Outpatient	Retrospective cohort	Low	D&E	–	22.4	18– 24	–	548	512	36
Mark (29)	2018	USA	Outpatient and hospital	Retrospective cohort	Some	Suction D&C or D&E	–	–	"first-and second-trimester"	29.3	2468	1831	637
Murphy (20)	2012	USA	Hospital	Retrospective cohort	Low	D&E	Physicians	23	13 – 24	26	1044	900	144
Patel (18)	2006	USA	Outpatient	Retrospective cohort	Some	D&E	Physicians	–	12 – 24	–	2095	1972	123
Schneider (30)	1994	Israel	Hospital	Retrospective cohort	Some	D&E	–	–	14– 22	–	806	769	37
Wilson (19)	2011	USA	Outpatient	Retrospective cohort	Low	D&E	Physicians	25.8	12– 18	26.2	587	516	71

BMI, body mass index; CS, caesarean section; D&E, dilation and evacuation; MVA, manual vacuum aspiration; D&C, dilation and curettage.

Further breakdown of the risk of bias is available in Supplementary Table 3.

Surgical complications

Overall complication rates (any surgical complication; minor and major) were pooled using data from all ten studies[8,18–20,25–30], including a total of 17,637 participants. Across both trimesters, 178/3123 (5.7 %) women with a history of previous CS and 484/14,514 (3.3 %) women without previous CS experienced any type of surgical complication (OR = 2.00, CIs = 1.32–3.04, p = 0.001; 10 studies) (Fig. 2 & Table 3). The overall quality of evidence was assessed as 'low' due to substantial heterogeneity among studies (60 %), which was explained by a further analysis and the risk of bias of the included studies (Table 3).

Major complications occurred in 154 (0.9 %) participants; 56/2123 (2.6 %) women with a history of prior CS and 98/11,157 (0.9 %) women without prior CS experienced a major complication (OR = 2.82, CIs = 1.83–4.36, p < 0.0001; 8 studies) (Fig. 3). The overall quality of evidence was evaluated as 'moderate' because of the risk of bias of the included studies (Table 3).

Six studies reported on the overall complication rate in women with a history of > 1 previous CS[8,18,25,27–30]; there was no significant difference in adverse outcomes in those with multiple (>1) CS compared to a single previous CS. 71/950 (7.5 %) women with > 1 previous CS experienced a complication, compared to 79/1559 (5.1 %) women without a history of prior CS (OR = 1.78, CIs = 0.83–3.79, p = 0.14; 6 studies) (Fig. 4 & Table 3). The overall quality of evidence was judged to be 'very low' due to substantial heterogeneity among studies (60 %), which was explained by a further analysis of the number of previous CS, and the risk of bias of the included studies (Table 3).

Second-trimester subgroup analysis demonstrated higher major complication rates among women with previous CS (56/2123; 2.6 %) than among those without prior CS (98/11086; 0.9 %) (OR 2.82, 95 % CI 1.82–4.37; p < 0.00001; 8 studies) (Supplementary Fig. 1).There was not enough data reported for the first trimester to be included in the analysis.

Specific major complications; emergency hysterectomy

Most studies reported a combination of major complications without detailing the numbers of specific adverse events. There was insufficient data to analyse haemorrhage complications, blood transfusions, uterine perforations, the need for laparotomy or laparoscopy, or the need for repeat surgical evacuation as individual adverse events when comparing women with and without a prior CS. No cases of uterine rupture during cervical priming were reported. These reports on specific major complications are limited mainly due to their rarity. Emergency hysterectomy was the only complication with sufficient reported data in the included studies that allowed us to perform a meta-analysis.

Seven studies with 11,660 participants reported on rates of need for emergency hysterectomy as a major complication of surgical abortion [8,18,19,27–30]. A total of six women (0.05 %) required hysterectomy; 3/1973 women with a prior history of CS, and 3/9687 women without a history of CS (OR = 8.73, CI = 1.83–41.61, p = 0.007; 7 studies) (Fig. 5 & Table 3). Given the limited number of hysterectomy events, the Mantel-Haenszel method was used for meta-analysis. The overall quality of evidence was assessed as 'low' due to the risk of bias of the included studies and wide CIs of the pooled data, which impacted the imprecision of the results (Table 3).

Publication bias was not detected in any of the above analyses using visual representation on funnel plot (Supplementary Figs. 2–5) and Egger's regression test (Table 3).

Discussion

Complications of surgical abortion are reasonably uncommon; however, they occur more frequently in the second trimester, and this meta-analysis suggests women with a history of CS experience surgical complications at higher rates than those who have never had a CS. To our knowledge, this is the first meta-analysis to examine the impact of previous CS on adverse outcomes at the time of surgical abortion. The overall complication rate amongst those undergoing surgical abortion was 3.8 %, with a major complication rate of 0.9 %. Women with a history of a previous CS had more than twice the risk of experiencing a

Table 2
Surgical abortion complications in women with and without previous caesarean.

Author (ref)	Complications									
	Any complication			Major complication			Complications by number of prior CS		Hysterectomy	
	Overall	No prior CS	Prior CS	Overall	No prior CS	Any prior CS	1 prior CS	>1 prior CS	No prior CS	Prior CS
Ben-Ami (8)	27(4.2 %)	23 (4.2 %)	4 (4.4 %)	2 (0.3 %)[a]	2(0.4 %)	0 (0.0 %)	2 of 59	2 of 32	0	0
Frick (25)	214[b](7.2 %)	–	–	38 (1.3 %)[c]	20 (0.9 %)	18 (2.8 %)	4 of 409	14 of 234	–	–
Guiahi (26)	57(2.9 %)	40 (2.5 %)	17 (4.7 %)	3 (0.2 %)[d]	–	–	–	–	–	–
Lederle (28)	442 (9.8 %)	333 (9.4 %)	109 (11.1 %)	78 (1.7 %)[e]	52[f] (1.5 %)	26[f] (2.7 %)	61 of 598	48 of 380		2
Lohr (27)	32 (5.9 %)[g]	–	–	1 (0.2 %)[h]	0 (0.0 %)	1(2.8 %)	–	–	0	1
Mark (29)	54 (2.2 %)[i]	37 (2.0 %)	17 (2.7 %)	–	–	–	11 of 378[j]	6 of 259[j]	0	0
Murphy (20)	64(6.1 %)	–	–	23 (2.2 %)[k]	14 (1.6 %)	9 (6.3 %)	–	–	–	–
Patel (18)	–	–	–	10 (0.5 %)[l]	8 (0.4 %)	2 (1.6 %)	1 of 91	1 of 32	2	0
Schneider (30)	2 (0.2 %)[m]	2 (0.3 %)	0 (0.0 %)	0(0.0 %)	0 (0.0 %)	0 (0.0 %)	0 of 24	0 of 13	0	0
Wilson (19)	8 (1.4 %)	7 (1.2 %)	1 (1.7 %)	2 (0.3 %)[n]	2 (0.3 %)	0 (0.0 %)	–	–	1	0

[a] Any complications included cervical laceration, postoperative fever, perforation, uterine rupture, blood transfusion and retained products of conception. Major compliction included perforation, uterine rupture and blood transfusion, of which there was only b cases of blood transfusion in this study.
[b] Overall complication rates not stratified by previous CS; only major complications were analysed by previous CS.
[c] Major complication: transfusion, need for uterine artery embolisation (UAE), laparoscopy/laparotomy, disseminated intravascular coagulation (DIC).
[d] Any complication: need for repeat procedure, perforation, EBL > 100 cc, cervical laceration, retained products of conception, anaesthetic complication. Major complication: there were c cases of intraop haemorrhage requiring further treatment including a requiring hysterectomy and transfusion. Paper did not specify if these women had previous CS hence excluded from analyses of major comp/hyserectomy.
[e] Major complications: hospitalization, transfusion, UAE, laparotomy, hysterectomy.
[f] Numbers calculated by odds ratio given for major complications in each group.
[g] A total of 543 participants included in the analysis of overall complications in this study.
[h] Delivery prior to theatre, atony without haemorrhage and failed procedure have been excluded from analysis as these were not considered major complications for the purpose of the meta-analysis. There was one case meeting criteria for major complication who had haemorrhage > 500 ml requiring transfusion, DIC and hysterectomy. It is noted that this case is in the setting of abnormal placentation.
[i] Complications included hemorrhage, need for repeat evacuation, uterine perforation, cervical laceration, medication reaction, unexpected surgery, or unplanned admission to the hospital.
[j] Used data for any complication from this study as “major complications” not stated separately. See footnote j above for list of complications included.
[k] Minor complications were defined as cervical or vaginal laceration, estimated blood loss between 100 mL and 250 mL, need for admission or reoperation, endometritis, retained products of conception, need for additional postoperative antibiotics, chorioamnionitis, preterm premature rupture of membranes or delivery outside of operating room (i.e., after preoperative arrival but before entering the operating room). Severe complications were defined as estimated blood loss greater than 250 mL, need for laparoscopy or laparotomy, uterine perforation, bowel injury, bladder injury, hysterectomy, abruption, disseminated intravascular coagulation, placement of uterine balloon catheter, pelvic infection, deep vein thrombosis, pulmonary embolism or intensive care unit admission. Only major complications (not minor complications) were reported by previous history of caesarean.
[l] Major complications: haemorrhage > 500 ml, laparotomy, hysterectomy, perforation, sepsis, DIC, death, hospital admission. Only major complications reported in this study.
[m] b Cases of atony with haemorrhage not requiring transfusion; both in women without prior caesarean.
[n] Major complications: severe haemorrhage with transfer to hospital.

major complication; including major haemorrhage, need for transfusion, hospital admission, need for laparotomy/laparoscopy or hysterectomy. This is an important finding in the era of ever-increasing caesarean rates globally[9].

The findings of this meta-analysis are significant but must be interpreted with caution due to the overall low quality of evidence and heterogeneity between studies; however, the subgroup analysis for major surgical complications had moderate quality evidence that caesarean section increases risk. Due to the rarity of major adverse outcomes during surgical abortion, retrospective cohort studies are often individually underpowered to detect significant differences. This meta-analysis has shown statistically significant differences in outcomes comparing women with history of CS to those without; however, notably, there were only a pooled total of 3123 participants with previous CS. Given that some outcomes such as life-threatening haemorrhage and need for hysterectomy occur in less than 1 in 1000 women, there is a need for further large studies and case-control studies examining severe adverse outcomes.

There was insufficient data to perform a sub-group analysis on first trimester surgical abortion, with only one paper[26] reporting solely on complications of first trimester surgical abortion in women with and without prior CS. In Guiahi’s paper, major complications during the first trimester were rare (0.2 %) and a history of prior CS increased the risk of complications overall (OR = 1.9, CI 1.1–3.4)[26]. Although major complications are very rare during the first trimester, it is possible that with rising rates of caesareans there will be an increase in undiagnosed CSP that has potential to cause severe haemorrhage[31–34]. It is prudent to recommend pre-operative ultrasound by a gynaecologist or sonologist with skills in diagnosing CSP for women with prior CS who are planning to undergo surgical abortion, however it must be noted that the sensitivity for diagnosis of abnormal placentation in early pregnancy is only 41 %, thus cases of CSP and PAS may still go undetected[35].

Pridmore et al published a case series in 1999 that was the first study to report prior uterine surgery as a risk factor for perforation during surgical abortion procedures[4]. This study is not included in our meta-analysis as it did not provide numbers of women with and without prior CS. It was not feasible to contact the authors to request access to the required data due to the date of publication. The paper offers

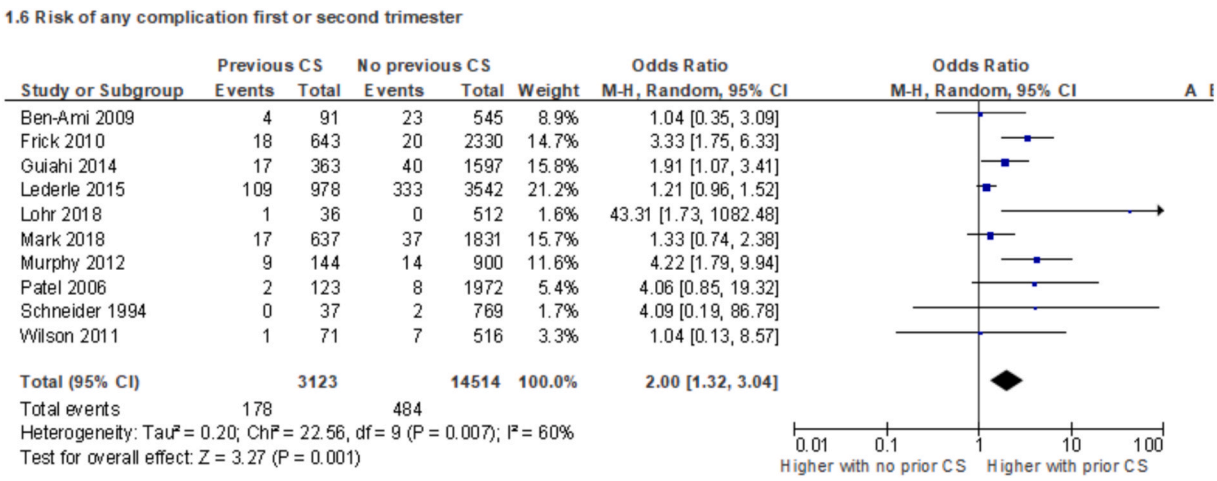

Fig. 2. Forest plot for the risk of **any surgical complication** events associated with surgical abortion in the first or second trimester in women with vs. without previous caesarean, using a random-effects model.

Table 3
Summary of the results for the effect of prior caesarean on risk of complications associated with surgical abortion.

	Studies (n)	Sample size (n)	Events (n)	OR [95 % CIs]	Heterogeneity (%)	p-value of publication bias	Evidence quality	GRADE[c]
Any surgical complications	10	17,637	662	2.00* [1.32, 3.04]	60* Substantial	0.65	⊕⊕OO Low	Risk of bias: some [d] Inconsistency: some [f] Indirectness: no Imprecision: no Publication bias: no
Major surgical complications	8[a]	13,280	154	2.82* [1.83, 4.36]	20 Low	0.27	⊕⊕⊕O Moderate	Risk of bias: some [d] Inconsistency: no Indirectness: no Imprecision: no Publication bias: no
Any surgical complication > 1 CS vs 1 CS	6[a]	2,509	6	1.78 [0.83, 3.97]	55 Moderate	0.93	⊕OOO Very low	Risk of bias: high [e] Inconsistency: some [f] Indirectness: no Imprecision: no Publication bias: no
Hysterectomy	7[b]	11,660	6	8.73* [1.83, 41.61]	0 Low	0.95	⊕⊕OO Low	Risk of bias: some [e] Inconsistency: no Indirectness: no Imprecision: some [g] Publication bias: no

OR, odds ratio; CIs, confidence intervals.
* **p-value was statistically significant for the overall effect of the test, test of heterogeneity (with the significance of < 0.1), or publication bias (with the significance of < 0.1).**
a The results of one study were not estimable.
b The results of three studies were not estimable.
[c] Quality of the evidence was assessed for each outcome according to Grading of Recommendations, Assessment, Development, and Evaluations (GRADE). Below are the reasons to downgrade each criterion:
[d] Most information is from studies with low and some risk of bias (−1 downgraded).
[e] Most information is from studies with high and some risk of bias (−2 downgraded).
[f] There was heterogeneity between studies, which was explained by sub-group analyses (−1 downgraded).
[g] There was a wide 95 % Cis around the pooled effect (−1 downgraded).

recommendations and describes the protocol that was initiated and appeared effective in reducing the risk of perforation in those with prior uterine surgery in their large abortion service in South Australia. At the time of publication, the caesarean rate amongst patients seeking abortion at their centre was only 3 %; however, 3/60 (5 %) of those with a prior CS experienced a perforation over a 4-year period prior to implementation of the new protocol. In the 2 years following the protocol introduction, there were no cases of perforation. Their recommendations included the introduction of intraoperative ultrasonography for all second trimester surgical abortions and highlighted the importance of passive dilation of the cervix pre-operatively using misoprostol and/or laminaria [4]. The authors of this meta-analysis would also

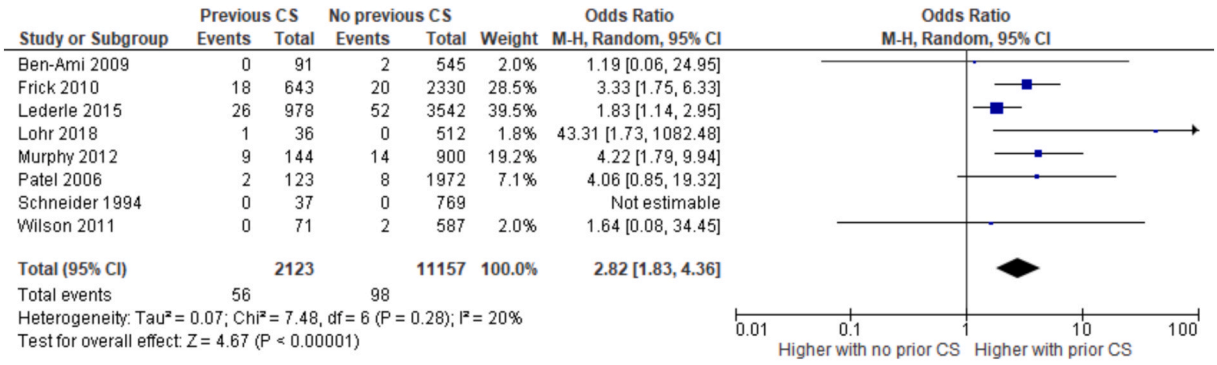

Fig. 3. Forest plot for the risk of **major surgical complication** events associated with surgical abortion in the first or second trimester in women with vs. without previous caesarean, using a random-effects model.

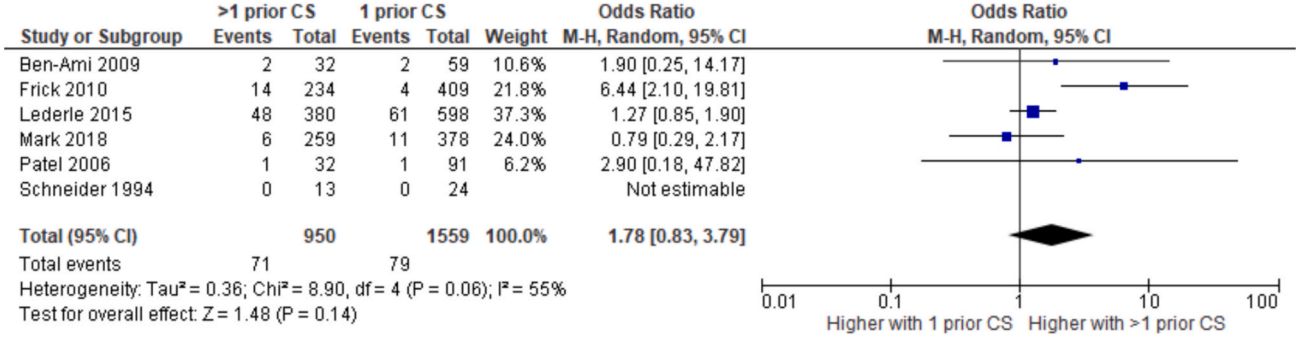

Fig. 4. Forest plot for the risk of **any complication** of surgical abortion in women with multiple (>1) previous CS vs. a single previous caesarean, using a random-effects model.

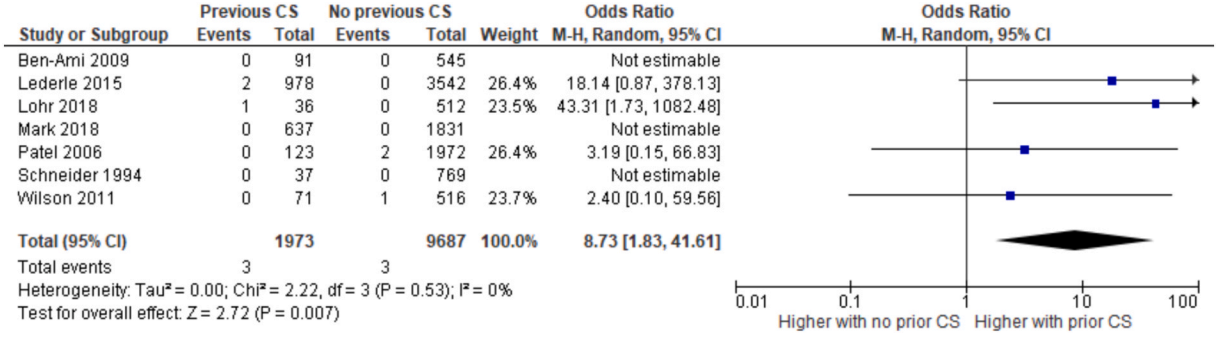

Fig. 5. Forest plot for the risk of **emergency hysterectomy** as a complication of surgical abortion in women with vs. without previous caesarean, using a random-effects model.

recommend that an experienced abortion provider should always be involved in the care of second trimester surgical abortion for women with prior CS. The lack of any cases of uterine rupture during cervical ripening in this review also emphasises the safety of pre-operative misoprostol and laminaria/osmotic dilator use, which is extremely important in reducing risks of major adverse outcomes, especially in this population who may be at increased risk of scarring of the internal os and difficult dilation.

There is a need for large studies examining the impact of multiple prior caesarean sections on surgical abortion outcomes. The pooled data from studies reporting outcomes for women with > 1 previous CS did not show an increase in risk of overall adverse outcomes compared to women with only a single previous CS, but the numbers were relatively small and there was insufficient evidence for analysis of women with > 2 CS. This becomes a critical question as women with more than one CS presenting for abortion care are increasingly encountered in modern clinical practice[36]. Furthermore, women with more than 1 previous CS have increased risks of uterine rupture during second trimester medical termination[5], and it remains unclear whether surgical abortion confers improved safety over medical abortion for this group of women.

Limitations of this meta-analysis include that only papers available in English were included. Of note, 7/10 included articles were from the United States of America, and all were from high-income countries, limiting the applicability of these results to low- and middle-income countries. Another limitation is the variation in definitions of 'major' and 'minor' complications between studies. We had pre-defined criteria per protocol for classification of complications; however, not all papers had extractable data on individual outcomes, thus detailed notes are provided in the footnotes of Table 2 regarding specific outcomes for each study. Strengths include the use of GRADE to assess certainty of evidence, and subgroup and sensitivity analyses, where required, to address

heterogeneity and determine the effect of each predefined criterion and the overall outcome to assist in better interpretation of results.

This meta-analysis synthesises and quantifies existing evidence demonstrating that previous caesarean section is associated with increased overall and major complication rates during surgical abortion, with a greater effect observed in the second trimester. We would encourage publication of further large studies to capture uncommon outcomes, and guidance on optimising procedural safety should be a priority for future research.

CRediT authorship contribution statement

Natalie Drever: Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization. **Vinay Gangathimmaiah:** Validation, Investigation. **Zinat Mohammadpour:** Writing – review & editing, Validation, Methodology, Formal analysis. **Cecelia O'Brien:** Writing – review & editing, Supervision. **Catriona Melville:** Writing – review & editing, Supervision, Conceptualization. **Kirsten Black:** Writing – review & editing, Supervision. **Caroline de Costa:** .

Ethics approval

Not applicable.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejogrb.2026.114948.

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