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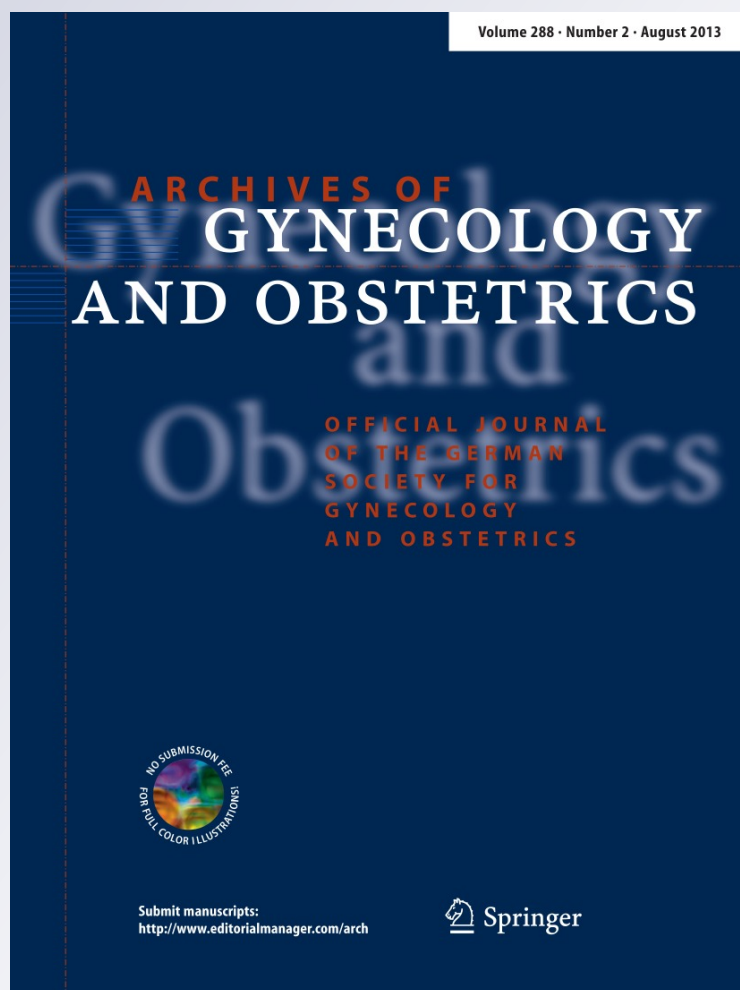
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# Uterine perforation as a complication of surgical abortion causing small bowel obstruction: a review

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## Abstract

**Objective** Small bowel obstruction after unrecognized or conservatively treated uterine perforation is extremely rare. It is a surgical emergency and the delay in diagnosis and treatment has deleterious consequences for the mother. The purpose of this study is to critically review the available literature and ascertain the level of evidence for the mechanisms, diagnosis and management of small bowel obstruction after uterine perforation due to surgical abortion.

**Methods** Systematic literature search was conducted in Pubmed (1946 to 2012) and Pubmedcentral (1900 to 2012) including all available English and French language full-text articles. Three evaluators reviewed and selected all available case reports and case series. Search terms included small bowel obstruction, bowel obstruction, bowel incarceration, bowel entrapment, vaginal evisceration, uterine perforation, uterine rupture, and abortion. The exclusion criteria were (1) complex injuries where small bowel incarceration was present but with bleeding and/or bowel perforation as the leading symptomatology; (2) articles only numbering the patients without details on the topic. Analyses of incidence, risk factors, mechanisms of the disease, time of clinical presentation, diagnostic modalities, treatment, and maternal outcome were included.

**Results** Of the 73 articles screened 30 cases of small bowel obstruction were included in the review forming incidence, risk factors, and mechanisms of the disease, diagnosis, therapy, and maternal outcome.

**Conclusions** A systematic review defined four mechanisms of small bowel obstruction after transvaginal instrumental uterine perforation with significant variations in clinical presentation and time of presentation. Duration of symptoms depend on the mechanism of small bowel obstruction. Vaginal evisceration is surgical emergency and treatment is mandatory without diagnostic workup. Survival rate during last century is 93 %. Multicentric trials and publication of all such cases are needed to determine algorithms for diagnosis and management of small bowel obstruction caused by instrumental uterine perforation.

**Keywords** Small bowel obstruction · Uterine perforation · Abortion · Mechanism

## Introduction

Let alone the fact that abortion is an extremely sensitive topic everywhere, it is perhaps unreasonable to expect reliable data about abortion practices, especially in Africa or India, where even vital registration—the recording of births, deaths, and marriages—is far from complete and accurate [1]. Most illegal abortions are conducted in the rural areas of developing nations without adequate facilities and by persons with no knowledge of anatomy who operate with non-sterile instruments with increased percentage of mortality and morbidity [2–6]. As per the World Health Organization (WHO) estimates for the year 2000, about 19 million unsafe abortions occurred worldwide, resulting in the deaths of about 70,000 women [7]. One

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extremely rare but important complication is small bowel obstruction after surgical abortion due to uterine wall perforation. Small bowel is most commonly injured with uterine perforation because of its central pelvic location, length, and mobility [3].

As yet, there have been no review articles or meta-analyses of observational studies on the subject. Therefore, in the present study, we aimed to investigate incidence, risk factors, mechanisms of small bowel obstruction, clinical presentation, diagnosis, treatment, and maternal outcome via MOOSE criteria for the observational studies.

## Methods

### Study selection

We conducted a systematic literature search of Pubmed published from 1946 to 2012 and Pubmedcentral from 1900 to 2012 including all available English and French language fulltext articles. We identified case reports dealing with small bowel obstruction after surgical abortion. The search terms were: 'small bowel obstruction', 'bowel obstruction', 'bowel incarceration', 'bowel entrapment', 'vaginal evisceration', 'uterine perforation', 'uterine rupture', and 'abortion'. All the searches were restricted to human studies. All the potentially relevant articles were independently reviewed by two investigators (Augustin and Luetic). Disagreements between evaluators were resolved by discussion or consultation with a third author (Majerovic M).

The exclusion criteria were (1) complex injuries when small bowel incarceration was present but with bleeding and/or bowel perforation as the leading symptomatology, (2) uterine perforation after dilation and curettage after labor for any cause, and (3) articles on the topic only numbering the patients without important data.

One flaw found in included articles is that some important procedures are not described precisely such as abortion. The terms used are 'abortion', 'surgical abortion' or 'instrumental abortion' without precisely defining the procedure itself.

### Data synthesis

The study aimed to investigate incidence, risk factors, mechanisms of small bowel obstruction, clinical presentation, diagnosis, treatment, and maternal outcome. Most of the outcome measures were unsuitable for meta-analysis, and we calculated crude estimates. Several interrelations were analyzed: (1) Possible influence of pregnancy duration and other possible risk factors on incidence, (2) mechanism of small bowel obstruction on duration of

symptoms, (3) duration of symptoms and vital signs on outcome, and (4) extension of resection on outcome.

### Statistical analysis

Adequate statistical analysis was not possible due to the lack of one or more of analyzed data in almost every study included. Only possible relations in percentages could be calculated.

## Results

### Identification of relevant studies

Table 1 shows studies with relevant data. Of the 73 articles screened we identified 30 cases having the majority of data important for this study. There is only one important study excluded, by Ntia et al.; even though it had the largest number of patients (nine patients), only the abstract was available and it presented only one of four mechanisms of small bowel obstruction (see "[Mechanisms of small bowel obstruction](#)"). The results of this study were used in the discussion for the comparison with some of our results.

### Characteristics of the studies included in the analyses

30 cases were included. The problem with data interpretation is that in this extremely small group of studies (patients), detailed description is lacking. In some case reports some important data are missing and in others with case series, cumulative data are presented and it is impossible to further analyze the subgroups defined in our study. The percentages were calculated not from the entire group of 30 cases but from the number of available data for the specific factor analyzed. The Meta-analysis of observational studies in epidemiology (MOOSE) guidelines was consulted throughout the conduct of the study and MOOSE checklist presented (Table 2).

## Discussion

### Incidence and trimester distribution

Worldwide, there are 30–50 million induced abortions [7, 9]. First trimester surgical abortion is one of the most frequently performed procedures in the United States: 853,485 procedures were performed in 2001 [10]. In a large study evaluating morbidity, Hakim-Elahi et al. [11] reported incidence of minor complications after first trimester surgical abortion of 0.846 %, including mild infection, resuctioning on the day of procedure, or

**Table 1** Characteristics of cases included regarding small bowel obstruction after uterine perforation due to surgical abortion

References	Age	Gravida/ Para/ Abortion	Pregnancy duration	Abortion method	Risk factors	Duration of symptoms	Blood pressure	Pulse (min)	X-ray
Whitall [26]	23		4 months	Dilation and curettage	Retained part of placenta 1 year ago	2 h	Normal	Normal	No
Palmer [27]	28		8 weeks	Dilation and curettage		5 days	Normal	96	No
Sarnoff [28]	26		10 weeks	Surgical	Unknown	1 h	Hypotensive	120	No
Wolff and Limarzi [29]	30								
Haddad and Haddad [30]				Criminal		2 h			
Cooke [37]	33	G3P3	10 weeks	Abortion	Abortion 6 months ago—no data	4 days	116/90	96	Yes
Shenoi et al. [54]	23	G1P1	8 weeks	Criminal	No	30 h	130/70	100	No
Dunner et al. [46]			13 weeks	Suction	Cesarean section	1 h			No
McArdle et al. [52]	31	G2P?A2	8 weeks	Suction	No	24 h	Normal	Normal	Yes
Leibner [12]	30	G3P1	<12 weeks	Suction	No	22 days	130/70	68	Yes
Oludiran and Okonofua [57]						Less than 24 h			No
Oludiran and Okonofua [57]						Less than 24 h			No
Oludiran and Okonofua [57]						More than 48 h			
Oludiran and Okonofua [57]						More than 48 h			
Oludiran and Okonofua [57]						More than 48 h			
Sherigar et al. [53]	34	G6P5A0	12 weeks	Dilation and curettage	No	2 h	Hypotensive	120	No
Shulman et al. [47]	36	G9P6	9 weeks	Surgical	Unknown	2 days		85	No
Jhobta et al. [6]			<12 weeks	Abortion					
Jhobta et al. [6]			<12 weeks	Abortion					
Chang et al. [33]	39	G3P2A1	7 weeks	Dilation and curettage	Failed medical abortion/2 previous cesarean sections	24 h	Normal	Normal	Yes
Nkor et al. [39]	36	G5P5	12 weeks	Abortion	No	4 months	Normal	Normal	Yes
Seow-En et al. [36]	30	G2	34 weeks	None	Retained part of placenta 2 year ago	2 years	Normal	Normal	
Aworinde et al. [58]	22	G2P2	12 weeks	Criminal	Unknown	10 h	80/40	120	No
Gupta et al. [55]	30	G7P6	14 weeks	Unsafe	Unknown	2 h	80/50	146	No
Dossou 2012 [40]	18	G1P0	8 weeks	Abortion	Unknown	2 h	90/50	120	No
Dossou et al. [40]	30	G1P0		Dilation and curettage	Unknown	24 h	120/80	88	No
Coughlin et al. [38]	21	G2P0A2	18 weeks	Dilation and curettage	2 elective abortions	3 weeks	Normal	Normal	Yes
Lebeau et al. [56]	25	G0P0	13 weeks	Criminal	No	12 h	90/60	115	No
Aliyu and Salihu [35]	25	G3P2A2	8 weeks	Surgical	Failed medical abortion	24 h	90/60	104	No
Werelius [22]	20			Criminal		6 h		90	No

References	Transabdominal Ultrasonund	Transvaginal Ultrasound	CT scan	Mechanism of obstruction	Operative procedure	Site/size of uterine injury	Uterine injury treatment	Outcome
Whitall [26]	No	No	No	Vaginal evisceration	Resection (350 cm) with anastomosis	Fundus	Sutures	Survived
Palmer [27]	No	No	No	Vaginal evisceration	Resection (98 cm) with anastomosis	Fundus (2.5 cm)	Sutures	Survived

**Table 1** continued

References	Transabdominal Ultrasonund	Transvaginal Ultrasound	CT scan	Mechanism of obstruction	Operative procedure	Site/size of uterine injury	Uterine injury treatment	Outcome
Sarnoff [28]	No	No	No	Vaginal evisceration	Resection (450 cm) with anastomosis	Anterior (2.5 cm)	Hysterectomy	Survived
Wolff and Limarzi [29]				Vaginal evisceration	Resection (150 cm)	3 cm		Survived
Haddad and Haddad [30]				Vaginal evisceration	Resection with anastomosis		Hysterectomy	Survived
Cooke [37]	No	No	No	Ileal adhesion	Adhesiolysis	Posterior (1.5 cm)	Hysterectomy	Survived
Shenoi et al. [54]	No	No	No	Vaginal evisceration	Resection (390 cm) with anastomosis	Fundus (3 cm)	Hysterectomy	Survived
Dunner et al. [46]			No	Bowel in uterine wall		Anterior		Survived
McArdle et al. [52]	Yes	Yes	No	Bowel in uterine wall	Viable small bowel			Survived
Leibner [12]	No	No	No	Herniated omentum with strangulated small bowel	Resection (5 cm) with anastomosis	Two (1 cm) perforations	Not repaired	Survived
Oludiran and Okonofua [57]			No	Vaginal evisceration	Resection with anastomosis		Sutures	Survived
Oludiran and Okonofua [57]			No	Vaginal evisceration	Resection with anastomosis		Sutures	Survived
Oludiran and Okonofua [57]				Bowel in uterine wall	Resection with anastomosis		Sutures	Survived
Oludiran and Okonofua [57]				Bowel in uterine wall	Resection with anastomosis		Sutures	Survived
Oludiran and Okonofua [57]				Bowel in uterine wall	Resection with anastomosis		Sutures	Survived
Sherigar et al. [53]	No	No	No	Vaginal evisceration	Resection (400 cm) with anastomosis	Fundus	Sutures	Survived
Shulman et al. [47]	Yes	Yes	No	Bowel in uterine wall	Resection (18 cm) with anastomosis			Survived
Jhobta et al. [6]				Vaginal evisceration	Resection (anastomosis)	Fundus		Survived
Jhobta et al. [6]				Vaginal evisceration	Resection (all small bowel) with stoma	Anterior or fundus		Died
Chang et al. [33]	Yes	No	Yes	Bowel in uterine wall	Resection with anastomosis	Lower segment (cesarean section scar)	Sutures	Survived
Nkor et al. 2009 [39]	Yes	Yes	No	Ileal adhesion	Resection (10 cm) with anastomosis	Fundus		Survived
Seow-En et al. [36]				Richter type hernia	Adhesiolysis	Anterior (2 cm)	Sutures	Survived
Aworinde et al. [58]	No	No	No	Vaginal evisceration	Resection (200 cm) with anastomosis	Fundus (3 cm)	Sutures	Survived
Gupta et al. [55]	No	No	No	Vaginal evisceration	Resection (100 cm) with anastomosis	Fundus	Sutures	Survived

**Table 1** continued

References	Transabdominal Ultrasonund	Transvaginal Ultrasound	CT scan	Mechanism of obstruction	Operative procedure	Site/size of uterine injury	Uterine injury treatment	Outcome
Dossou et al. [40]	No	No	No	Vaginal evisceration	Resection (200 cm) with anastomosis	Posterior	Sutures	Survived
Dossou et al. [40]	No	No	No	Vaginal evisceration	Resection (200 cm) with anastomosis	Uterus (1 cm)	Sutures	Survived
Coughlin et al. [38]	Yes	Yes	Yes	Ileal adhesion	Resection (10 cm) with anastomosis	Fundus	Sutures	Survived
Lebeau et al. [56]	No	No	No	Vaginal evisceration	Resection (2.5 m) with anastomosis	Fundus	Sutures	Survived
Aliyu and Salihu [35]	No	No	No	Vaginal evisceration	Resection (30 cm) with anastomosis	Posterior (4 cm)	Sutures	Died
Werelius [22]	No	No	No	Vaginal evisceration	Resection (365 cm) with anastomosis	Fundus	Sutures	Survived

subsequent resuction, cervical stenosis, cervical tear, underestimation of gestational age, and convulsive seizure after local anesthesia. Major complications requiring hospitalization have ten times less incidence (0.071 %) and include incomplete abortion, sepsis, uterine perforation, vaginal bleeding, inability to complete abortion, and combined (heterotopic) pregnancy. Uterine perforation during abortion is rare, with incidence of 0.05–0.4 % [12–17] but up to 3.6 % in undeveloped countries [18].

Small bowel obstruction caused by uterine perforation due to surgical abortion, as one of major complications, is extremely rare. Our study included 30 patients after surgical abortion in the period 1907–2012 due to adequacy of the data. There are less than 50 patients in the literature and the remainder was excluded due to only numbering or clustering in the articles without important data for this study. First described in 1864, the total number of case reports of all cause vaginal evisceration (as one mechanism of small bowel obstruction after surgical abortion), is less than 100 cases [19]. Extremely rare incidence of small bowel obstruction after uterine perforation due to surgical abortion is due to

- (1) rare occurrence of instrumental uterine perforation
- (2) spontaneous healing of most (recognized and unrecognized) uterine perforations without further complications [16, 20]
- (3) immediate laparotomy/laparoscopy in 47–84 % of cases with recognized complicated uterine perforation [14, 17]
- (4) unknown number of cases not published in the medical literature
- (5) prehospital mortality, especially in undeveloped countries [21]

Therefore real incidence is unknown, higher than published, but still, fortunately, extremely low. The first known published case of vaginal evisceration as one form of small bowel obstruction due to uterine perforation after instrumental abortion is from 1864 with several cases published between 1907 and 1911 [22–26] and then from 1923 to 1924 [27, 28]. New cases were then published in the middle of the twentieth century [29, 30] and then in average of two cases in every decade up to 2005 when every year at least one case was published (Table 1).

Approximately 71 % (15/21) of these complications occurred during the first trimester surgical abortion and remaining 27 % (6/22) during the second trimester. The distribution of this complication through the trimesters is contrary to the fact that second trimester abortion has a higher rate of all complications than abortions performed in the first trimester [13, 15, 31]. This is due to (1) higher incidence of (legal or illegal) surgical abortions during the first trimester and (2) thickening of the uterus as pregnancy advances lowering the possibility of instrumental perforation.

#### Risk factors

In an attempt to identify factors potentially leading to uterine perforation, several authors determined that the level of training was the strongest statistically significant risk factor for perforation [8, 32]. Other factors were advanced maternal age, greater parity, retroverted uterus, history of prior abortion or cesarean section, history of previous cone biopsy, failure to use ultrasound, and underestimation of the duration of pregnancy [13–15, 33]. According to the study Amarin and Badria, uterine perforations were mostly located at the uterine fundus,

**Table 2** MOOSE checklist for small bowel obstruction due to uterine perforation after surgical abortion

Criteria	Brief description of how the criteria were handled
<b>Background</b>	
Problem definition	Small bowel obstruction due to uterine perforation after surgical abortion is rare but potentially devastating event. There are no pathophysiologic mechanisms described and no diagnostic and therapeutic algorithms present on the subject
Hypothesis statement	Construction of diagnostic and therapeutic algorithms could increase maternal survival rate and minimize intraoperative and postoperative complications
Description of study outcomes	Incidence, risk factors, mechanisms of small bowel obstruction, clinical presentation, diagnosis, treatment and maternal outcome
Type of exposure or intervention used	Small bowel obstruction
Type of study designs used	We included available fulltext case reports.
Study population	We placed no restriction.
<b>Search strategy</b>	
Qualifications of searchers	The credentials of the three investigators GA, TL and MM are indicated in the author list
Search strategy, including time period included in the synthesis and keywords	PubMed from 1946 to 2012 PubMedCentral from 1900 to 2012
Databases and registries searched	PubMed and PubMedCentral
Search software used, name and version, including special features	We did not employ search software
Use of hand searching	We did not use hand search
List of citations located and those excluded, including justifications	Only full text articles were included
Method of addressing articles published in languages other than English	We placed no restrictions on language; local scientists fluent in the original language of the article were contacted for translation
Method of handling abstracts and unpublished studies	We had contacted a few authors for unpublished studies on the association
Description of any contact with authors	We contacted authors of the articles that were not available in fulltext
<b>Methods</b>	
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Detailed inclusion and exclusion criteria were described in the Methods section
Rationale for the selection and coding of data	Data extracted from each of the studies were relevant to the population characteristics, study design, mechanisms, diagnostic modalities and therapeutic interventions and maternal outcome
Assessment of confounding	Possible confounding factor could be previous intraperitoneal surgery causing adhesions of small bowel to the uterus
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	Study quality is assessed by the comprehensiveness of the data in each case report
Assessment of heterogeneity	There was no heterogeneity of the studies due to case report nature of the studies
Description of statistical methods in sufficient detail to be replicated	Statistics is made only in percentages due to small sample
Provision of appropriate tables and graphics	We included one table for MOOSE checklist, one table of all studies, four figures of small bowel obstruction mechanisms, two figures of pelvic ultrasound findings and one computed tomography scan of small bowel incarceration through uterine wall
<b>Results</b>	
Figures of small bowel mechanisms	Figures 1, 2, 3, 4
Figures of pelvic ultrasound	Figures 5 and 6
Figure of computed tomography scan	Figure 7
Table giving descriptive information for each study included	Table 1



**Table 2** continued

Criteria	Brief description of how the criteria were handled
Discussion	
Quantitative assessment of bias	Due to small number of studies assessment of bias could not be conducted
Justification for exclusion	We excluded studies with (1) complex injuries when small bowel incarceration was present but with bleeding and/or bowel perforation as the leading symptomatology, (2) uterine perforation after dilation and curettage after labor for any cause and (3) articles on the topic only numbering the patients without important data
Assessment of quality of included studies	All fulltext case reports on the subject were included
Conclusions	
Consideration of alternative explanations for observed results	Confounding factor could be previous intraperitoneal surgery causing adhesions between small bowel and uterus. We did not find such cases in our study
Generalization of the conclusions	One should be cautious with generalization because only half of published studies are analyzed and certainly there are cases without medical documentation especially in Africa where this pathology is most common
Guidelines for future research	We recommend publishing of every case on the subject for construction of more precise diagnostic and therapeutic algorithms
Disclosure of funding source	No separate funding was necessary for the undertaking of this systematic review

presumably caused by the introduction of cervical dilators [34]. Hence, difficulty during cervical dilatation also has been associated with a higher perforation rate, and some authors recommend prostaglandin use to aid in dilatation of the cervix [13, 15]. Additionally, prostaglandins have the benefit of contracting the uterus, which may help decrease the perforation rate [14]. In our study, 63 % of cases (12/19) had perforation in the fundus confirming the results of previous studies also in this subpopulation of complicated uterine perforations. Currently, there are no known risk factors for small bowel obstruction after uterine perforation. Unfortunately, there are insufficient data for the conclusions but three factors could cause the increase of the incidence (Table 1):

- (1) failed medical abortion [33, 35]
- (2) curettage for retained parts of the placenta after previous pregnancy [26, 36]
- (3) diameter of uterine perforation
- (4) multiple pregnancies

Ad 2. It should be added that Chang et al.'s other possible explanation, although farfetched, could be that it was a cesarean scar pregnancy (one of the rarest form of ectopic pregnancy) where the uterine wall is the weakest and more likely to perforate after endometrial curettage [33].

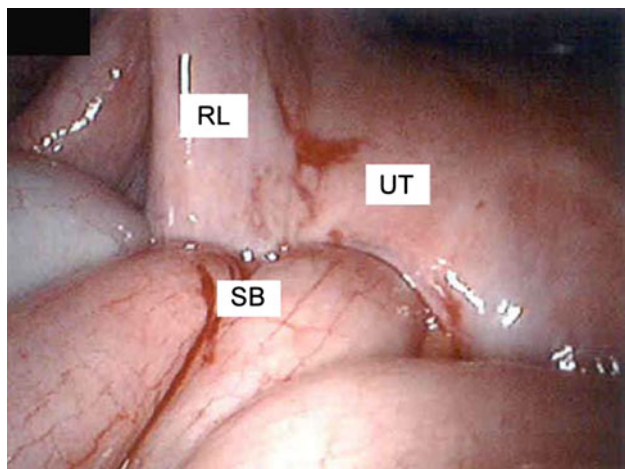
Ad 3. All cases with described size of uterine perforation had diameter larger than 1 cm and 70 % (7 out of 10) had perforations larger than 2 cm (Table 1). It could be hypothesized that the larger the size of perforation the easier for the bowel to incarcerate through the uterine wall or to eviscerate. From the data available conclusion cannot be made whether the size of the uterine perforation increases the possibility of adhesion formation with the small bowel.

Ad 4. Sixteen patients had documented previous pregnancies. Only one patient was nulliparous, three (19 %) had one pregnancy, four (25 %) had two pregnancies, and eight (50 %) had three or more pregnancies. The authors did not analyze correlation with previous pregnancies due to the lack of data and also with abortions because it is known that abortions are not always recorded in the medical documentation.

We conclude that we should be cautious with these proposed risk factors due to the small number of patients and these observations should be scientifically tested.

#### Mechanisms of small bowel obstruction

There are four documented mechanisms of small bowel obstruction after uterine perforation due to surgical abortion; the most common is the small bowel prolapse (Fig. 1) through uterine perforation due to inadvertent aspiration, spontaneous protrusion through large perforation or inadvertent pulling of small bowel. The incidence of small bowel incarcerated in the uterine wall is 23 %. The most extensive type is when the small bowel loops are pulled out of vaginal introitus (Fig. 2) present in additional 60 % of patients (Table 1). This mechanism is responsible for the majority of cases (83 %). Vaginal evisceration of small bowel is the final pathophysiologic event of the several causes which can sometimes coexist [35]: (1) radiation due to gynecologic cancer, (2) gynecologic surgery, (3) enterocele, (4) coital injury/rape, (5) douching, (6) enema expulsion, (7) speculum insertion, (8) fall and (9) spontaneous (thin and stretched-out vaginal apex); therefore history taking is crucial.

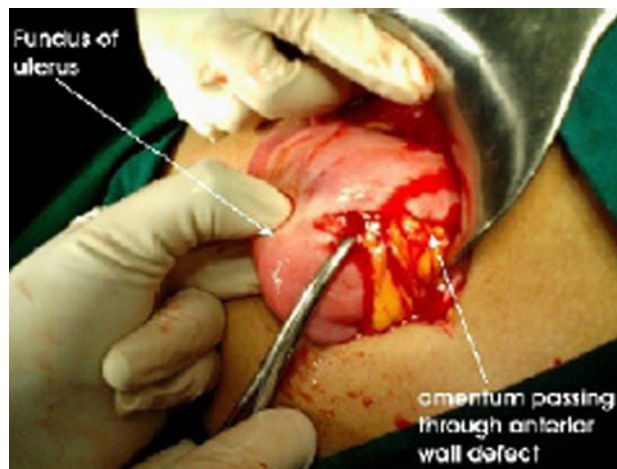


**Fig. 1** Intraoperative photograph demonstrates a defect in the anterior myometrium of the uterus (*UT*) at the level of the left round ligament (*RL*), through which small bowel (*SB*) has become incarcerated [47]

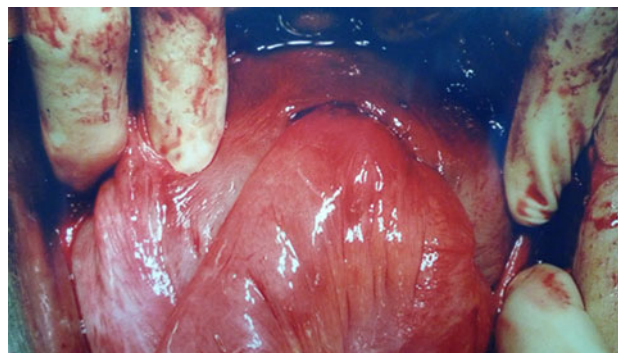


**Fig. 2** Congested and edematous intestinal loops pulled out of vaginal introitus 2 h following evacuation of the uterus done for an incomplete abortion [55]

The second mechanism is present when uterine perforation contains incarcerated herniated omentum (Fig. 3) [59], and a band attached to the omentum strangulates a segment of the extrauterine small bowel producing obstruction. It was documented in only one patient making the incidence of 3 % [12]. The third mechanism operates when the small bowel is entrapped in adhesions at the site of uterine perforation with incidence of 10 % [37–39]. One possible confounding factor could be previous intraperitoneal surgery causing adhesions between small bowel and uterus. We did not find such cases in our study. Fourth mechanism is obstruction as Richter type of hernia when the antimesenteric wall of the intestine protrudes through a defect in the uterine wall with rare incidence of 3 % (Fig. 4) [36]. Our explanation for long period of



**Fig. 3** Intraoperative photographs showing greater omentum incarcerated through the anterior wall defect of the uterus [59]



**Fig. 4** Richter type hernia showing antimesenteric side of small bowel wall partially incarcerated in the uterine wall

symptomless Richter type small bowel obstruction follows. During the first pregnancy (2 years previously), a dilation and curettage had been performed 4 weeks after delivery to remove the retained placenta. During instrumentation the uterine wall perforation occurred with formation of Richter type hernia but without ischemia of the small bowel wall. In the advanced stage of second pregnancy, growing uterus resulted in the compression and occlusion of the small bowel that was fixed to the uterus previously as Richter type of hernia.

#### Clinical presentation

The uterine perforations are usually recognized at the time of the dilation and curettage. If unrecognized, majority of patients have uncomplicated course with spontaneous healing of uterine perforations (see “[Incidence and trimester distribution](#)” section). The type and time of presentation depend on two pathophysiologic processes that could coexist (iatrogenic bowel perforation is excluded):

- (1) mechanism of small bowel obstruction
- (2) (Associated) bleeding
  - a. from uterine wall around perforation and
  - b. from the mesentery detached from its bowel [40]

Ad 1. The mechanism of small bowel obstruction dictates the severity, intensity, and time of presentation of obstruction. If adhesions are the cause of partial or progressive small bowel obstruction than non-specific symptoms including abdominal pain with/without distension, vomiting, (paradoxal) diarrhea or absence of flatus and/or stool is present. Fever and chills are present in the advanced stage when small bowel gangrene ensues. A serious consideration of this possibility is necessary, as the intrauterine location of strangulated bowel may mask the characteristic peritoneal signs [12]. Ischemic bowel perforation should be pathophysiologically differentiated from the direct bowel injury during instrumental uterine perforation. Such injuries develop clinical picture mostly within few hours after the procedure [41]. In our study duration of symptoms due to adhesions was from 4 days to 4 months in four patients (Table 1). These symptoms cause the delay in diagnosis because the patients with partial obstruction are commonly managed conservatively [42]. Presentation after 2 years was due to Richter type of hernia. Presentation of Richter hernia is not predictable. It can incarcerate initially with early presentation or other pathophysiologic event should be present for initiation of obstruction. Probably it depends partly on the size of uterine perforation. Such mechanism of delayed presentation was present in one patient in our study [36]. If the incarceration of the bowel through uterine wall is present and not recognized during abortion and if complete obstruction due to bowel prolapse through the uterine wall is the cause, then all patients presented from 1 to 48 h after uterine instrumentation (Table 1). If the small bowel is prolapsed in a form of vaginal evisceration the diagnosis is evident clinically due to the vaginal small bowel prolapse.

Ad 2. Any mechanism of small bowel obstruction could be accompanied by hemorrhage either from uterine wall perforation or detached mesentery from its bowel. Clinically, hemorrhage from uterine wall perforation is evident due to transvaginal bleeding but mesenteric bleeding can present either with transvaginal or intraabdominal bleeding or both. An intraabdominal bleeding presents as abdominal pain and should be always looked for because the pain can be attributed to abdominal pain caused by coexisting small bowel obstruction with abdominal distension. It is difficult to conclude is hemorrhage or small bowel obstruction dominant in these patients because variations in severity of developing obstruction and variations in severity of bleeding could be present. In our study 7 of 18 patients were hypotensive making it 39 %.

## Diagnosis

Diagnostic algorithm depends on the clinical presentation. If patient presents with vaginal evisceration with history of recent surgical abortion, additional diagnostic workup is unnecessary especially when the patient lost significant amount of blood. In our study all 14 patients where detailed diagnostic algorithm was described were sent directly to operating room without any diagnostic modality performed.

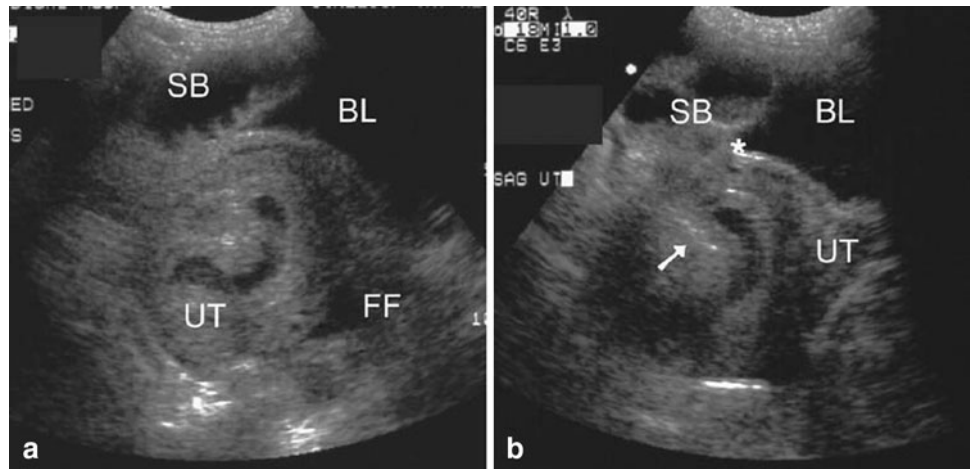
When non-specific symptoms including abdominal pain with/without distension, vomiting, diarrhea, or absence of stool and/or flatus are present, plain abdominal X-ray is mandatory. In our study, 12 patients presented without vaginal small bowel prolapse. Eight patients had data about diagnostic workup and plain abdominal X-ray was performed in seven (87.5 %). Unfortunately, it is impossible to have detailed data regarding how much time elapsed after first presentation until plain abdominal X-ray was performed because the timing is as important as the percentage of its use in this subpopulation. The diagnosis is likely when air–liquid levels of small bowel are evident on plain abdominal X-ray.

In the emergently presenting patient, ultrasound is the preferred diagnostic modality for the gynecologist, but it should be recognized that the normal appearance of the uterus after a first trimester surgical abortion can be quite variable [43–45]. Ultrasound diagnosis of uterine perforation with suspected bowel entrapment was first reported in 1983 by Dunner et al. [46]. Defect in the uterine wall could be detected with the transabdominal ultrasound. Tubular-shaped irregular tissue could be seen within the endometrial cavity, with a small echoic focus suggesting the presence of air (Fig. 5). An abnormally increased amount of echogenic free fluid could be seen in the cul-de-sac [47]. In all cases without vaginal evisceration with documented diagnostic workup transabdominal ultrasound was performed (five patients).

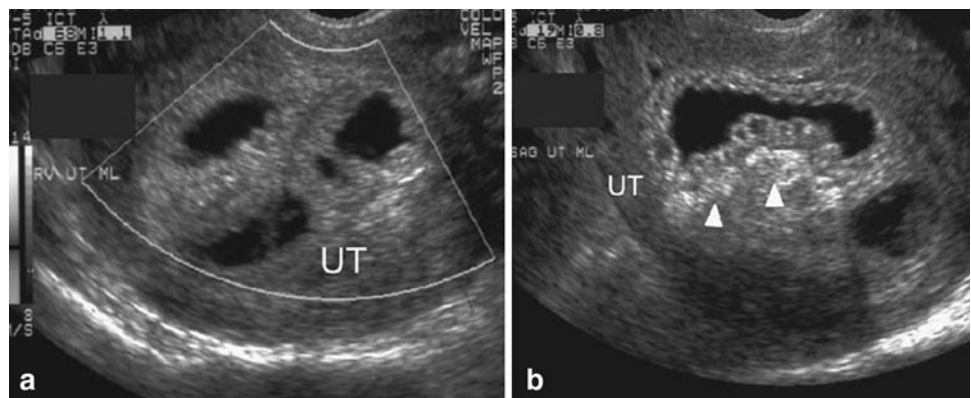
Transvaginal sonography can delineate free fluid in the pelvis, loops of bowel within the myometrial wall, extra-uterine fetal parts or intraoperative presence of the curette within the myometrium and is used to confirm uterine perforation [48]. It can also delineate bright, serpiginous, fluid-filled tubular structures within the endometrial cavity (Fig. 6). It was used in four of five aforementioned patients in our study (80 %). It is not indicated if the diagnosis is clear on transabdominal ultrasound or vice versa. Adjacent material of increased echogenicity could be suggestive of fat. Color Doppler would not show blood flow in these structures and no peristalsis would be seen in the intra-uterine contents [47]. There are not data about its use in our study, so further conclusions cannot be drawn.

The first reported CT diagnosis of incarcerated bowel in a uterine perforation was by Chang et al. [33] in 2008.

**Fig. 5 a and b** Transabdominal pelvic ultrasound images demonstrate a retroverted uterus (*UT*) adjacent to the urinary bladder (*BL*) with adjacent fluid filled small bowel (*SB*) closely apposed to an interrupted uterine wall (*asterisk*). A tubular structure is seen within the uterus. A small amount of anechoic free fluid (*FF*) is seen in the cul-de-sac. Linear echogenicity (*arrow*), consistent with the appearance of gas, is adjacent to the abnormal intrauterine tubular structure [47]



**Fig. 6** Transvaginal pelvic ultrasound demonstrates multiple tubular structures containing anechoic fluid within the uterine cavity (*UT*). Sagittally, echogenic material (*arrowheads*), suggesting the presence of fat, is adjacent to the intrauterine tubular structure [47]



**Fig. 7** Pelvic computed tomography scan taken after failure of conservative treatment. Intrauterine mass was later shown to be an incarcerated bowel [33]

Evaluation with CT has an important diagnostic role in cases where ultrasound is ambiguous or if nongynecological pathology is suspected. Although the uterine wall can hinder visualization of intrauterine bowel loops, Dignac et al. emphasize that the bowel's mesentery can be well visualized on CT scan due to its fatty nature, and should be

a red flag for intrauterine bowel [33], and bowel loops within the uterus can be seen (Fig. 7). In our study only two patients had abdominal CT scan. There are two reasons: (1) routine CT use during past several decades and (2) clinical diagnosis, or diagnostic plain abdominal X-ray or pelvic ultrasound eliminate the need for CT diagnosis.

Finally, abdominal/pelvic MRI has been utilized to assess the endometrial cavity after a first trimester surgical abortion [44], but it is not routinely performed on an emergent basis. There is only one case showing incarceration of the greater omentum in the uterine perforation but without bowel obstruction [49]. In our study and available literature, no case of small bowel obstruction due to uterine perforation using MRI has been observed.

### Therapy

Uterine perforations should be divided into uncomplicated and complicated ones. Most uterine perforations recognized during abortion without complications could be managed conservatively [14, 15]. Kaali et al. [16] managed conservatively 22 perforations after 7,114 elective abortions, with a significant number of these perforations

detected during combined laparoscopy. This implies that the true perforation rate may be under-reported and under-recognized without severe consequences to patients, suggesting that conservative management of uncomplicated uterine perforations with close observation is typically adequate [14, 50, 51].

The diagnosis or even suspicion of intrauterine bowel/bowel injury (complicated uterine perforation), however, mandates emergency laparotomy or laparoscopy. Emergency laparotomy/laparoscopy is necessary to prevent the progressive bowel distention with ensuing ischemic necrosis and/or subsequent perforation of the bowel. During laparotomy/laparoscopy the bowel should be reduced into the peritoneal cavity and evaluated for vitality. The involved herniated bowel may be strangulated, have direct bowel wall trauma, or may be devascularized by coexistent injury or incarceration of the mesentery [42]. In our study, in all cases of vaginal evisceration resection was necessary. In 14 of 18 patients the length of resected small bowel was measured. In only one patient the resected length was 30 cm and in all others the minimal resected length was 100 cm. In 56 % of patients (10/18) more than 200 cm was resected. In the subgroup of patients with ileal adhesion (three patients), the resection of ischemic bowel was necessary in two patients (67 %). The question is whether the bowel could be saved with earlier diagnosis and operation earlier in the course of the disease, but the answer cannot be made because of the lack of all necessary data.

Diversion in form of a stoma was made in only one patient with complete small bowel resection. It should be performed in patients with hemorrhagic shock or in sepsis due to late presentation with gross purulent and/or fecal contamination of the peritoneal cavity. Our study with isolated small bowel obstruction shows that resection with anastomosis is preferred treatment in patients without peritonitis.

Uterine perforation/laceration should be repaired after treatment of small bowel injury. Sometimes uterine perforation should be enlarged for easier pulling of the bowel into peritoneal cavity minimizing the possibility of further bowel and mesenteric damage (two patients) [40, 52]. Rarely, a hysterectomy is required if the uterus is necrotic or irreparable [41, 48]. Hysterectomy was performed in four of the 7 patients from the first half of the century and none after 1966. Our conclusion is that uterine debridement with suture repair is the procedure of choice despite description of one patient without repair of uterine perforation where perforation size was 1 cm [12].

Further surgical and perioperative treatment strategy was not analyzed in our study due to the lack of data, but it should be mentioned. Preoperative consultation with the patient for permanent sterilization should be done because during operation short additional procedure could prevent

repeating of complications of further abortions. During surgical exploration a search for mutilated fetus should be done [53] with definitive curettage if necessary. Perioperative antibiotics should be administered as in bowel obstruction in general. During follow-up, ultrasonogram of the uterus and  $\beta$ HCG measurement should be performed to eliminate the possibility of retained products of conception [53].

### Prognosis

Worldwide, there are 30–50 million induced abortions that result in the death of 80,000–110,000 women of which an estimated 34,000 are in Sub-Saharan Africa [7, 9]. Appropriately timed surgical intervention in complicated uterine perforation is crucial to decrease morbidity and mortality rates. Available data in our study show the survival rate of 93 % (two deaths) during whole century (1907–2012). One patient died due to massive small bowel necrosis where resection with high jejunostomy was made. The girl left the hospital against medical advice for social and family reasons and died [6]. Our assumption is that high jejunal stoma with high output caused dehydration and electrolyte imbalance, finally causing death. The second patient had additional sigmoid colon laceration treated during initial operation with resection and anastomosis. The authors write that the patient became febrile and deteriorated on the fourth postoperative day. Our assumption is that dehiscence of colorectal anastomosis with diffuse stercoral peritonitis and subsequent septic shock with multiorgan failure ensued [35]. The results of this study show that excellent prognosis is present throughout whole century due to several reasons:

- 1) The population of these patients is young, mostly without comorbidities and can compensate significant pathophysiologic stress such as small bowel obstruction and/or perforation sometimes accompanied by various degrees of hemorrhage. Such conditions could be deleterious for old people especially with significant comorbidities.
- 2) Most patients present with evident small bowel obstruction either clinically as vaginal evisceration (60 % of patients) or during first 48 h with small bowel in uterine wall (23 % of patients) mostly diagnosed quickly and accurately with pelvic sonography. Small bowel obstruction in remaining patients was confirmed with plain abdominal X-ray before perforation ensued.
- 3) Complications of small bowel resection in young, healthy patients without advanced atherosclerosis are rare and even long segmental resections have good long-term prognosis.

**Conflict of interest** No conflicts of interest.

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