Journal of Pharmaceutical Research International

33(40B): 64-71, 2021; Article no.JPRI.72067
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Causes and Management of Uterine Perforation- A Review

Mazen Bishrah[1*], Linah Saleh Abbas[2], Muhannad Abdullah Almalki[3], Rehab Ahmad Alquzi[3], Nada Atiah Alotaibi[4], Ayman Fahad Almazyad[5], Layan Hussain Alharbi[6], Safa Khalaf Almashyakhi[4], Bashayer Hussain Alnasser[7], Sarah Hassan Alsubaie[7] and Zainab Abdullah Jadher[8]

[1]Consultant of Obstetrics and Gynecology and IVF, International Medical Center, Jeddah city, Saudi Arabia.
[2]Albaha University, Saudi Arabia.
[3]Umm Al Qura University, Saudi Arabia.
[4]Taif University, Saudi Arabia.
[5]Alrass General Hospital, Saudi Arabia.
[6]Tabuk University, Saudi Arabia.
[7]Princess Nourah University, Saudi Arabia.
[8]Dar Aluloom University, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i40B32264
Editor(s):
(1) Dr. R. Deveswaran, M. S. Ramaiah University of Applied Sciences, India.
Reviewers:
(1) Jimmy A. Billod, Baguio General Hospital and Medical Center, Philippines.
(2) T. R. Sudha, Rajiv Gandhi university of Health Sciences, India.
Complete Peer review History: https://www.sdiarticle4.com/review-history/72067

Review Article

Received 02 June 2021
Accepted 07 August 2021
Published 09 August 2021

ABSTRACT

Uterine perforation is an intrauterine problem that can occur with any therapy. It is a rare but possibly dangerous consequence of uterine manipulation, evacuation of retained products of conception or pregnancy termination (TOP), hysteroscopic treatments, and coil implantation. Injury to blood arteries or viscera, such as the bladder or the intestine, might be related. Severe bleeding or infection may ensue if not discovered at the time of surgery; nevertheless, the most majority of

E-mail: gmforms2@gmail.com;

uterine drilling is subclinical and safe without treatment, with no substantial long-term damage. Perforation can be caused by cervical stenosis during trans-cervical operations or by a reduction in myometrial wall strength during pregnancy or menopause. Uterine abnormalities, infection, recent pregnancy, and postmenopause are all factors that raise the chance of uterine perforation. The treatment of uterine perforation is determined by the operation and the equipment employed. Admission to the hospital, intravenous antibiotics, and close supervision are required following a uterine perforation and any accompanying injuries. In this paper, we overview common causes and updated management of uterine perforation. Data was collected during a period of 6 months searching Pubmed, EPISCO, Web of science data bases to include studies with relative topics.

Keywords: Uterus; perforation; IUD; complications; management; abortion.

1. INTRODUCTION

Uterine perforation is an intrauterine problem that can occur with any intervention. It is a rare but potentially harmful consequence of uterine intervention, evacuation of retained products of conception or pregnancy termination (TOP), hysteroscopic treatments, and coil implantation. Damage to blood vessels or viscera, like the bladder or the intestine, might be related. Perforation can be caused by cervical stenosis during trans-cervical operations or by a reduction in myometrial wall strength during pregnancy or menopause [1].

Uterine perforation can result in significant morbidity and even death; however, early detection and treatment can optimize clinical results. It is a condition that all gynaecologists are aware of, but subsequent examination and care must be regulated. The majority of perforations occur in the uterine body and are generally tiny, resulting in minimal bleeding. Perforations at the internal cervical os and lower section of the uterus, on the other hand, are much more severe since they are frequently lateral and might include uterine vessel branches. This might result in the development of a hematoma in the wide ligament or severe intra-peritoneal bleeding [2,3].

Factors that increase the risk of uterine perforation include uterine anomalies, infection, recent pregnancy and post menopause. TOP is the most common procedure associated with uterine perforation. Diagnosis of perforation is not always easy and may require not only radiological investigation without preliminary preparation but also hysterography, ultrasound examination and hysteroscopy. Management of uterine perforation depend on the procedure being carried out and on instruments used. Following a uterine perforation and any associated injuries, admittance to hospital, intravenous antibiotics and close observation is necessary [4,5].

2. INTRAUTERINE DEVICES

Intrauterine devices (IUDs) are a common type of contraception worldwide. Considering 14% of women globally utilizing an IUD, it is the second most common type of contraception after female sterilization [6]. Perforations of the uterus caused by I.U.D. continue to be severe problems. Because they are frequently asymptomatic, their prevalence varies greatly [7]. The risk of uterine perforation following IUD implantation varies from 0.1 to 3/1000 [8].

There are two forms of perforation: immediate perforation caused by a poor insertion method and secondary perforation caused by progressive uterine wall deterioration. The variables that predispose to the occurrence of these incidents are various, but prominent among them are the date of the insertion in the cycle and, more importantly, the time in relation to the previous pregnancy, parity, position of the uterus, and operator's experience [7].

The sound, the device, or both can cause uterine perforation. If the sound or inserter penetrates farther than expected (more than 10–11 cm) and no resistance is felt, the instrument or device should be removed from the uterus instantly and the procedure should be terminated. If perforation is expected after device implantation, an ultrasound scan can be performed promptly if the necessary facilities and expertise are available, otherwise it can be scheduled via an imaging department [5].

Perforation is not detected in around 90% of instances at the time of IUD implantation. Even with a full perforation, the threads are usually still coming from the cervical os at the end of the procedure. Perforation is occasionally suspected

between the time of insertion and the follow-up visit owing to persistent symptoms, most notably moderate lower abdomen discomfort. One of the primary goals of the 6-week follow-up is to rule out ejection and perforation. The threads are not evident in the majority of perforation instances after 6 weeks. However, not all women show up for this follow-up test. In a rare situations when the IUD is placed in the Douglas pouch, the device can be palpated on vaginal or rectal examination [5].

When there is a suspicion of an ectopic intrauterine device, the first imaging technique to be used is a pelvic ultrasound examination, and 3D imaging may be beneficial. If it is unable to locate the intrauterine device, an abdominal X-ray must be taken. The removal of an ectopic intrauterine device is advised [8]. Hysterography provides the greatest diagnostic assessment since it offers visibility of the whole uterine cavity, allowing the position of the IUD to be seen instantly in situations of embedding and perforation. Pelvic pneumography can distinguish between intraperitoneal and extraperitoneal sites of ruptured IUDs; it can be improved with hysterosalpingography and performed ambulatorily. Ultrasonography only confirms the presence or absence of an IUD, but it has the advantage of accurately displaying a concurrent pregnancy; the ultrasound is unreliable if the IUD is surrounded by omentum or intestinal loops; ultrasonography can be combined with hysterography for further benefit. Laparoscopy is still the most often used procedure for diagnosing uterine IUD perforation; when the device must be removed, a laparotomy is generally performed concurrently. A qualified and experienced operator is required for a successful laparoscopy [4].

Even if they are deemed harmless, perforated IUDs should be removed, according to experts. When not established, spontaneous IUD ejection must be validated using the same procedures used for perforation diagnosis or dilatation and curettage [4]. The procedure used to remove it varies greatly from case to case, with laparoscopy, laparotomy, and culdotomy being the most common. Perforation prevention should consider not only contraindications to insertion but also awareness of favorable variables, a rigorous method for insertion, and clinical supervision to screen for subsequent perforations [7]. Before choosing on the optimal technique of removal, it is important to understand the kind of perforation and the position of the ectopic IUD. Emergency hysterectomy is performed under specific conditions, such as bleeding, but elective hysterectomy needs the existence of other variables, such as a fibroid uterus. Only when the IUD is in the posterior cul-de-sac is a colpotomy performed [4].

Boyon, C. et al. [8] examined 11 cases of uterine perforation following intrauterine device implantation to identify risk factors for uterine perforation and define therapy, and observed that the symptoms were pelvic discomfort, pregnancy occurrence, or incapacity to remove the IUD. Seven patients had laparoscopy, two of whom required a switch to laparotomy, one of whom was treated only by laparotomy, and one who was missed to follow-up.

Over a 10-year period, a nationally prospective cohort study in New Zealand discovered 28 perforations among 17,469 insertions of the Multiload® Cu375 IUD (Merck and Co., Inc., White-house Station, NJ, USA), yielding an incidence of 1.6 per 1,000 insertions [9]. The same group discovered three perforations in 3,519 IUS insertions during a three-year period, yielding an incidence of 0.9 per 1,000 [10]. Each of these studies depict “real-life” outcomes, which provide a more accurate picture than clinical trials, particularly when IUDs are inserted by generalists. A Turkish hospital-based trial of the T-380A IUD revealed an incidence of 2.2 per 1,000 insertions after one year of follow-up [11]. Other surveys, which could not be as confident of the denominator, discovered lower rates; for example, a Finnish research assessed an incidence of 0.4 per 1,000 marketed devices [12]. According to one study, women who used an IUD for the first time had a greater perforation rate than women who had previously used the technique [13].

Severe damage to the viscera (e.g., intestine, kidney) and/or peritonitis have been mentioned as serious outcomes. A trio of symptoms has been recorded when the intestine is perforated: abdominal discomfort, fever, and intermittent diarrhoea. Rectal haemorrhage is another possibility. Bowel perforation can occur asymptomatically and be discovered as an accidental finding, such as during a hysterectomy. Symptoms of a perforated urinary tract include dysuria, frequency, suprapubic discomfort, hematuria, and recurrent urinary tract infections [5]. According to case studies, misplaced IUDs have caused intestinal

perforations and adhesions, leading to peritonitis [14]. Nevertheless, because various specialists have observed minimal or no adhesions with both contemporary non-irritating polyethylene-framed Cu-IUDs and the LNG-IUS, the need to remove intra-abdominal IUDs in asymptomatic instances has been frequently questioned [15,16]. Symptoms are caused by rare intestinal problems or extensive adhesions, which must be addressed. In comparison to the life-threatening symptoms listed in case reports [14], additional studies on IUD-associated perforations show that the vast majority of perforations are either asymptomatic or are correlated with mild symptoms such as abnormal bleeding, mild pain, or both, when associated with absent threads or unplanned pregnancy [17].

Although minimally invasive laparoscopic removal is preferable, open laparotomy may be safer in more difficult cases. A 2012 comprehensive analysis of laparoscopies performed for removal of ruptured IUDs found that 64% were effective and 35% required conversion to laparotomy [18]. The case series in that review were published between 1972 and 2002, and the scope of laparoscopic surgery has undoubtedly expanded in subsequent years. It may thus be claimed that a woman whose perforated IUD cannot be removed during the initial laparoscopy should be sent to a surgeon with particular abilities in minimum access surgery, who may be more likely to properly and securely remove a device than a general surgeon. Occasionally “discretion is the better part of valor” and laparoscopy or laparotomy is abandoned when retrieval is unsuccessful in cases where the device has become densely adherent to, or buried in, vital structures. It should be noted that surgery to remove an IUD may itself cause adhesion formation [19]. Laparoscopic removal is not feasible in type A and B perforations. However, type A perforations may well be amenable to removal of the device at hysteroscopy (Type A: IUD present in uterine cavity and myometrium; Type B: IUD present entirely in myometrium) [14]. A retrospective study of 75 patients reported that majority of patients had mild symptoms of abnormal bleeding or abdominal pain or both, in combination with missing IUD/IUS threads. IUDs were located using a combination of vaginal ultrasonography (US) and X-ray, hysteroscopy, or curettage. Patients were only treated by laparoscopy after that. The omentum was home to the bulk of the 68 intra-abdominal devices, with the remaining 24 (35 percent) centered in the uterus. In all seven cases (9 percent) with visible threads but unsuccessful removal by tugging, partial perforation or myometrial embedding was identified. Filmy adhesions were discovered in the bowel during laparoscopy (30%). Infections were uncommon; one non-specific severe abdominal infection, subsequently shown to be unrelated to the IUD, necessitated laparoscopy, and in four cases, the IUD was surrounded by pus but no symptoms existed [12].

After a perforation, the myometrium heals quickly. Often, no scar is evident on the uterus to reveal the exit location at laparoscopy a few days or weeks following IUD implantation and perforation [20]. Only one-third of the perforation sites in the Kho and Chamsy [21] series were identified. Scars would vanish two months after perforation, according to Zakin et al [14]. This is not always the case, and occasionally a scar does last a long period [22].

The best way to avoid uterine perforation is to use a precise and well-executed insertion method performed only by an expert operator and after a thorough pelvic check. Uterine size, consistency, and location must be precisely understood; IUD implantation is simpler during or soon after menstruation [4]. Actions that can help to reduce the risk of uterine perforation associated with insertion of IUDs include avoidance of insertion or taking extra care (with special consent) from 48 hours to 4 weeks postpartum, especially if the woman is breast-feeding, use of a plastic rather than a metal sound, use of a suitable tenaculum and applying appropriate traction to it, provision of less rigid introducers by device manufacturers, accurate setting of the flange on the introducer according to the sounding distance and the specific instructions for the device, a pull-back, rather than a push-out, release mechanism for the device, skilled insertion training for clinicians and insertion by experienced clinicians [5].

3. METHODS

Study Design: Review article.

3.1 Study duration Data were Collected between 1 February and 30 July 2020

Data collection: Medline and PubMed public database searches have been carried out for papers written all over the world on the most notable advances in uterine perforation. The

keyword search headings included “uterus, perforation, IUD, complications, management, abortion ", and a combination of these was used. For additional supporting data, the sources list of each research was searched. Criteria of inclusion: the papers have been chosen on the basis of the project importance, including one of the following topics: causes of uterine perforation, uterine perforation following curettage, first-trimester abortions, uterine perforation caused by pyometra etc.). Criteria for exclusion: all other publications that did not have their main purpose in any of these areas or multiple studies and reviews were excluded. The validity and minimization of error were double revised for each member 's results.

Uterine perforation following curettage: Diagnostic dilatation and curettage was originally designed to detect intrauterine endometrial abnormalities and aid in the treatment of abnormal bleeding. Newer methods for evaluating the uterine cavity and endometrial discoveries are now accessible [23]. However, dilatation and curettage continue to play a role in places where modern technology is unavailable or where other diagnostic techniques fail. Diagnostic dilation and curettage is commonly used to examine endometrial histology. Assessment of the endocervix and biopsy of the ectocervix and transformation zone are also included in fractional dilation and curettage [24].

The most common consequence of curettage is uterine perforation, which can cause bleeding, visceral injury, and peritonitis. Furthermore, hematoma development and any type of peritoneal trauma caused by uterine wall coagulation or suture may result in adhesion formation with pathologic consequences such as persistent discomfort, subsequent infertility, or acute ileus. As a result, immediate management of bleeding from uterine wall rupture is required to avoid an emergency hysterectomy or blood transfusion, as well as to prevent peritoneal adhesion development, persistent pelvic discomfort, and infertility [25].

Ziegler, Nicole, et al. [26] present a prevalence of active bleeding due to uterine perforation during curettage, where the perforation had ended up in persistent oozing of blood, as documented by laparoscopy, which could be treated instantly and successfully with an application of a hemostatic powder, the modified polysaccharide 4DryField®PH, avoiding coagulation or suturing.

Ben-Baruch, G et al. [27] found that 0.16 percent of 13,344 consecutive curettage patients suffered uterine perforation. The uterine fundus was the most commonly perforated location, and the most frequently used tool was a sharp curette. Perforation rates in curettage performed for postpartum haemorrhage and intrauterine adhesions were relatively high (5.1 and 1.8 percent, respectively); rates in those performed for elective abortion and postmenopausal bleeding were intermediate (0.4 and 0.2 percent, respectively); and rates in those performed for other indications were very low (less than or equal to 0.06 percent).

Uterine perforations during first-trimester abortions: Uterine perforations have been found to occur in the range of 1/250 to 1/1000 instances [28]. According to Kaali, S G et al., the risk of uterine perforation during first-trimester abortion is 0.8-6.4/1000 operations; however, in studies using direct pelvic imaging, the rate has been as high as 30/1000 procedures [29].

Hemorrhage, injury to surrounding viscera, inability to heal adequately, potential adhesion, and infection are the most serious complications of uterine perforation during pregnancy. The operator's experience, the length of gestation, the time of occurrence during abortion, the type of instrument causing the perforation, the penetration of adjacent structures into the uterus, the location of the perforation site (requiring endoscopy, laparoscopy, or laparotomy), and the availability of adequate manpower all influence the evaluation of these sequelae (nursing personnel, laboratory, and a ready operating room) [28].

Gynecologists continue to disagree on the occurrence and treatment of uterine perforation after first-trimester abortions. The treatment of such perforations should be determined by the location of the hole and the extent of the abortion. These questions must also be addressed: 1) How far along is the patient's pregnancy? 2) Is there any extragenital damage? 3) Is there evidence of hematoma development or ongoing intraperitoneal blood loss? The laparascope is useful in assessing perforation damage and evaluating whether laparatomy is required. If the bleeding is severe, a laparotomy is recommended for uterine and vascular repair, which may include hysterectomy. If the perforation is detected before the removal of all conception products, the plan is determined by the location of the perforation. If vital signs

remain stable, either 1) the patient may be returned to the operation room for a second evacuation, avoiding the region of perforation, or 2) the patient may be brought to the hospital for a laparascopic examination and evaluation for a second vaginal evacuation. If the hole seems to be lateral, with intraabdominal bleeding, the patient should be admitted to the hospital immediately for intensive observation [30].

Only laparotomy can safely empty the uterus in the case of an incomplete abortion combined with a perforation. Sharp curettes and suction tip curettes can cause more significant injuries than blunt instruments. Laparotomy is required if neighboring organs are pushed into the uterus. Most instances necessitate irrigating the abdomen with free blood, sufficient hemostasis, reperitonealization of viscera, and no prophylactic antibiotics unless there is rheumatic heart disease or chronic disabling illness [28].

An examination of the 84,850 lawful induced abortions conducted found incidences of uterine perforation (0.17 percent). 33.8 percent of these women had undergone at least one previous induced abortion. There were only four cases (2.8 percent) of uterine perforation in women whose uterine size surpassed weeks of pregnancy. The suction cannula (47.0 percent) and the Hegar dilator (40.0 percent) caused perforation in women (20.6 percent). In (47.6 percent) of these cases, immediate exploration of the abdomen (mainly laparotomy) was done; substantial bleeding and/or lacerations to organs located in the pelvis were detected in (26.1 percent) of these women. There was no evidence of intestinal perforation. The vast majority of injuries would have healed without the need for a laparotomy. A cautious approach to uterine perforation is suggested unless there is peritoneal irritation, increased discomfort, or indications of blood loss [31].

Uterine Perforation Caused by Pyometra: Pyometra, or the accumulation of purulent fluid in the uterine cavity, is a rare disease. Pyometra can be caused by a variety of gynaecological diseases, both malignant and benign, that result in cervical stenosis. Endometrial polyps, leiomyomas, cervical or endometrial cancer, and infection, particularly senile cervicitis, are all potential risk factors. Other risks to consider include an IUD that has been forgotten, cervical occlusion after surgery, and radiation. Furthermore, idiopathic causes should be considered [32,33].

The optimum treatment for a ruptured pyometra is an emergency laparotomy, peritoneal cavity irrigation, and subsequently a straightforward hysterectomy. Cervical dilatation and drainage, on the other hand, must be addressed in unruptured instances of pyometra. In instances when fertility should be preserved, abdominal cavity irrigation following uterine cavity evacuation and uterine perforation repair should be considered [34,35].

4. CONCLUSION

Uterine perforation is an uncommon condition that can have disastrous implications for women. It is linked with significant morbidity. Training programs under supervision, risk factor evaluation, and use of cervical preparation can all assist to decrease the chance of perforation. Caution should be mandatory in high-risk situations, and obtaining support from senior gynaecologists as well as other specialities in a timely way might not only help to reduce morbidity but also prevent any long-term consequences.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ferguson CA, Costescu D, Jamieson MA, Jong L. Transmural migration and perforation of a levonorgestrel intrauterine system: a case report and review of the literature. Contraception. 2016;93:81–86.
2. Royal College of Obstetrics and Gynaecology. Green-Top Guideline: Best Practice in Outpatient Hysteroscopy. London: RCOG; 2011.
3. Goldstuck ND, Wildemeersch D. Role of uterine forces in intrauterine device embedment, perforation, and expulsion. Int J Women's Health. 2014;6:735–744.
4. Kho KA, Chamsy DJ. Perforated intraperitoneal intrauterine contraceptive

devices: diagnosis, management and clinical outcomes. J Minim Invasive Gynecol. 2014;21:596–601.
5. Rowlands S, Oloto E, Horwell DH. Intrauterine devices and risk of uterine perforation: current perspectives. Open Access J Contracept. 2016;7:19-32. Published 2016 Mar 16. DOI:10.2147/OAJC.S85546
6. World Population Bureau, Family Planning Worldwide, Data Sheet; 2008. Available:http://www.prb.org/pdf08/fpds08.pdf 29 January 2013, date last accessed
7. Heinemann K, Reed S, Moehner S, Minh TD. Risk of uterine perforation with levonorgestrel-releasing and copper intrauterine devices in the European Active Surveillance Study on Intrauterine Devices. Contraception. 2015;91:274–279
8. Boyon C, Giraudet G, Guérin Du Masgenêt B, Lucot JP, Goeusse P, Vinatier D. Diagnostic et prise en charge des perforations utérines par dispositif intra-utérin: à partir de 11 cas [Diagnosis and management of uterine perforations after intrauterine device insertion: a report of 11 cases]. Gynecol Obstet Fertil. 2013; 41(5):314-21. French. DOI: 10.1016/j.gyobfe.2012.05.006. Epub 2012 Jul 19. PMID: 22818520.
9. Harrison-Woolrych M, Ashton J, Coulter D. Uterine perforation on intrauterine device insertion: is the incidence higher than previously reported? Contraception. 2003; 67:53–56.
10. Zhou L, Harrison-Woolrych M, Coulter DM. Use of the New Zealand Intensive Medicines Monitoring Programme to study the levonorgestrel-releasing intrauterine device (Mirena) Pharmacoepidemiol Drug Saf. 2003;12:371–377.
11. Caliskan E, Özturk N, Dilbaz BÖ, Dilbaz S. Analysis of risk factors associated with uterine perforation by intrauterine devices. Eur J Contracept Reprod Health Care. 2003;8:150–155.
12. Kaislasuo J, Suhonen S, Gissler M, Lähteenmäki P, Heikinheimo O. Intrauterine contraception: incidence and factors associated with uterine perforation – a population-based study. Hum Reprod. 2012;27:2658–2663. [PubMed] [Google Scholar]
13. Heinemann K, Reed S, Moehner S, Minh TD. Risk of uterine perforation with levonorgestrel-releasing and copper intrauterine devices in the European Active Surveillance Study on Intrauterine Devices. Contraception. 2015;91:274–279.
14. Zakin D, Stern WZ, Rosenblatt R. Complete and partial uterine perforation and embedding following insertion of intrauterine devices I. Classification, complications, mechanism, incidence and missing strings, Obstet Gynecol Surv. 1981;36:335-353) DOI:101097/00006254-198107000-00001
15. Adoni A, Ben Chetrit A. The management of intrauterine devices following uterine perforation, Contraception. 1991;43:77-81. DOI:101016/0010-7824(91)90128-3
16. Haimov-Kohman R, Doviner V, Amsalem H, Prus D, Adoni A, Lavy Y. Intraperitoneal levonorgestrel-releasing intrauterine device following uterine perforation: the role of progestins in adhesion formation, Hum Reprod. 2003b;18:990-993. DOI:10.1093/humrep/deg203
17. Heinemann K, Barnett C, Dinger J. Risk Factors for Uterine Perforations during IUD Insertion: Interim Results from the EURAS-IUD Study; 2011. Available:http://www.pharmacoepi.org/meetings/27thconf/presentations/Risk%20Factors%20for%20Uterine%20Perforations%20during%20IUD%20Insertion-%20Interim%20Results%20from%20the%20EURAS-IUD%20Study.pdf 29 January 2013, date last accessed
18. Gill RS, Mok D, Hudson M, Shi X, Birch DW, Karmali S. Laparoscopic removal of an intra-abdominal intrauterine device: case and systematic review. Contraception. 2012;85:15–18.
19. Markovitch O, Klein Z, Gidoni Y, Holzinger M, Beyth Y. Extrauterine mislocated IUD: is surgical removal mandatory? Contraception. 2002;66:105–108.
20. Margarit LM, Griffiths AN, Vine SJ. Management of levonorgestrel-releasing intrauterine system (LNG-IUS) uterine perforation. J Obstet Gynaecol. 2004;24: 586–587.
21. Kho KA, Chamsy DJ. Perforated intraperitoneal intrauterine contraceptive devices: diagnosis, management and clinical outcomes. J Minim Invasive Gynecol. 2014;21:596–601.
22. Selo-Ojeme DO, Eking ME, Welch CC. Uterine perforation and laparoscopic retrieval of a levonorgestrel intrauterine system (Mirena) J Obstet Gynaecol. 2003; 23:445–446.

23. Dysfunctional Uterine Bleeding. Emons SJ. Pediatric and Adolescent Gynecology. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2004.
24. Demirkiran F, Yavuz E, Erenel H, Bese T, Arvas M, Sanioglu C. Which is the best technique for endometrial sampling? Aspiration (pipelle) versus dilatation and curettage (D&C). Arch Gynecol Obstet. 2012;286(5):1277-82.
25. Ziegler N, Korell M, Herrmann A, et al. Uterine perforation following a fractional curettage successfully treated with the modified polysaccharide 4DryField® PH: a case report. J Med Case Rep. 2016;10(1): 243.
Published 2016 Sep 6.
DOI:10.1186/s13256-016-1029-x
26. Ziegler N, Korell M, Herrmann A, et al. Uterine perforation following a fractional curettage successfully treated with the modified polysaccharide 4DryField® PH: a case report. J Med Case Rep. 2016;10(1): 243.
Published 2016 Sep 6.
DOI:10.1186/s13256-016-1029-x
27. Ben-Baruch G, Menczer J, Shalev J, Romem Y, Serr DM. Uterine perforation during curettage: perforation rates and postperforation management. Isr J Med Sci. 1980;16(12):821-4.
PMID: 7192698.
28. Weitzner HB. The management of the perforated uterus in conjunction with 1st trimester abortions. J Med Assoc State Ala. 1981;50(8):13-6.
PMID: 8530903.
29. Kaali SG, Szigetvari IA, Bartfai GS. The frequency and management of uterine perforations during first-trimester abortions. Am J Obstet Gynecol. 1989;161(2):406-8.
DOI:101016/0002-9378(89)90532-2.
PMID: 2527465.
30. Freiman SM, Wulff GJ Jr. Management of uterine perforation following elective abortion. Obstet Gynecol. 1977;50(6):647-50.
PMID: 927753.
31. Lindell G, Flam F. Management of uterine perforations in connection with legal abortions. Acta Obstet Gynecol Scand. 1995;74(5):373-5.
DOI: 103109/00016349509024431.
PMID: 7778431.
32. Ou YC, Lan KC, Lin H, Tsai CC, ChangChien CC. Clinical characteristics of perforated pyometra and impending perforation: specific issues in gynecological emergency. J Obstet Gynaecol Res. 2010;36(3):661–6.
DOI: 101111/j.1447-0756.2010.01184.x.
33. Ikeda M, Takahashi T, Kurachi H. Spontaneous perforation of pyometra: a report of seven cases and review of the literature. Gynecol Obstet Invest. 2013;75 (4):243–9.
DOI: 10.1159/000349981.
34. Lim SF, Lee SL, Chiow AK, Foo CS, Wong AS, Tan SM. Rare cause of acute surgical abdomen with free intraperitoneal air: Spontaneous perforated pyometra. A report of 2 cases. Am J Case Rep. 2012; 13:55–7.
DOI: 10.12659/AJCR.882629.
35. Lee SL, Huang LW, Seow KM, Hwang JL. Spontaneous perforation of a pyometra in a postmenopausal woman with untreated cervical cancer and "forgotten" intrauterine device. Taiwan J Obstet Gynecol. 2007;46 (4):439–41.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/72067