



Inguinal hernia following the use of fluid anti-adhesive agents in laparoscopic surgery: a literature review and case report

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Introduction and importance: Inguinal hernia is a rare complication in females occurring due to the use of common anti-adhesion agents, such as ADEPT. Some complications have been reported to date; however, there are no reported cases of ADEPT-induced inguinal hernia.

Case presentation: A 39-year-old woman underwent laparoscopic ovarian cystectomy for a right ovarian endometrioma, using ADEPT as an anti-adhesion agent. Subsequently, she developed an inguinal hernia diagnosed using pelvic computed tomography. The inguinal mass gradually decreased in size and disappeared four months after, without intervention.

Clinical discussion: While rare complications have been reported, no cases of inguinal hernias induced by anti-adhesion agents have been reported to date. To minimize the risk of this complication, avoiding excessive intra-abdominal pressure to prevent possible peritoneal fluid migration through small orifices into low-pressure areas is advised. Additionally, applying external pressure over the superficial/deep inguinal rings until CO₂ is completely removed from the abdominal cavity might be helpful.

Conclusion: Inguinal hernia is a rare anti-adhesion solution complication in females. Minimizing the risk involves avoiding excessive intra-abdominal pressure and applying external pressure over the superficial/deep inguinal rings.

Keywords: Anti-adhesive agents, case report, inguinal hernia, laparoscopic surgery

Introduction

This case report has been reported in accordance with the SCARE Criteria^[1].

Adhesion formation is a common complication after gynaecologic surgeries^[2,3]. Currently, several FDA-approved anti-adhesion agents, including ADEPT solution (Baxter Healthcare), and site-specific barriers such as Interceed (Johnson & Johnson Patient Care Inc.), Gore-Tex (W. L. Gore and Associates, Inc.), and Sefrafilm (Baxter Healthcare) are available for gynaecologic surgeries.

Inguinal hernias can present with a wide range of symptoms, from asymptomatic to incarcerated hernia, strangulation, or bowel obstruction^[4]. The clinical presentation defines management. For asymptomatic inguinal hernias, observation is

HIGHLIGHTS

- Anti-adhesion agent can prevent adhesion formation after surgeries.
- Hernia is a rare complication of using fluid anti-adhesion agents.
- Anti-adhesion agent related inguinal hernia can be prevented by several ways.

acceptable; however, to prevent complications from a strangulated hernia, surgical management might be needed.

We reviewed relevant literature to understand rare surgery complications associated with the use of anti-adhesion agents such as 4% icodextrin solution. We aimed to provide recommendations for its safe use and prevent future morbidities. This case can guide future choices of anti-adhesive agents.

Case presentation

A 39-year-old woman, nulligravida, presented to our outpatient department complaining of lower abdominal discomfort and dysmenorrhoea for months. She denied any family member experienced these symptoms. At admission, cancer antigen 125 (CA-125) level was 93.1 U/ml; other data were unremarkable. Transvaginal sonography revealed a right heterogeneous ovarian cyst measuring ~5.8 cm.

Under general anaesthesia, a single-site laparoscopic right cystectomy with a 1.2-cm umbilical wound was performed by an experienced (> 10 years) surgeon on 04/08/2016. The lithotomy position with a modest Trendelenburg tilt was maintained. An average intraperitoneal pressure of 12–15 mmHg was maintained during the procedure. Intraoperatively, stage III

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endometriosis (American Society for Reproductive Medicine classification)^[5], some deep endometriosis spots on the right ovary and left uterosacral ligament, and partial obliteration cul-de-sac were observed. Laparoscopic adhesiolysis and cauterization of endometriosis were performed. The procedure lasted 1 h. Intraoperatively, 1 l of normal saline and 700 ml of ADEPT were used for irrigation. The exact irrigation balance was recorded, and it was assumed that most of the fluids were recovered. At the end of the procedure, 800 ml of anti-adhesive agent, ADEPT, was left in the peritoneal cavity. Pathological examination confirmed the right endometrioma diagnosis.

The patient complained of persistent flatus post-operatively. On 13/08/2016, a non-reducible, tender, 2-cm mass was noted near the right inguinal area and labium majus. Sonography scan on 23/08/2016 showed a 9.61 × 6.18 cm pelvic cyst (Figs. 1A) and 5.43 × 1.30 cm inguinal cysts (Fig. 1B). Laboratory data showed no signs of infection or bleeding. Pelvic computed tomography revealed an outpouching, herniating omentum sac with fluid over the right lower pelvis, compatible with right inguinal hernia without bowel incarceration (Fig. 2.) The patient was referred to general surgeons who recommended inguinal hernia repair to minimize the possibility of incarceration. However, she refused the treatment owing to the short interval between surgeries, her physical condition, time of hospital stay, and cost. She opted for a close follow-up using monthly sonographies (Fig. 1C, D). At the

2-month follow-up, the ileus had improved. The inguinal mass gradually decreased in size and disappeared after 4 months. The pelvic cyst near the right ovary disappeared after 9 months. During follow-up, there were no serious inguinal hernia-related conditions, nor did the patient express significant dissatisfaction with the treatment.

Discussion

Developing inguinal hernia after laparoscopic gynaecology surgery is rare; therefore, it is not discussed as a potential complication when counselling patients regarding this procedure. Here, we describe a rare complication due to the use of fluid anti-adhesive agents following laparoscopic treatment of ovarian chocolate cysts with endometriosis.

Inguinal hernia is a common congenital anomaly observed less frequently in adults. Most cases are indirect types, entering the inguinal canal through the internal ring. The congenital (or indirect) type results from the persistent patency of the processus vaginalis, whereas the direct type results from a weakening of the fascia transversalis^[6]. The processus vaginalis generally closes before 1 year of age. Failure of this closure establishes a persistent connection with the peritoneal cavity called the canal of Nuck; which predominantly occurs on the right side (bilateral involvement is seen in 10% of cases)^[7]. Figure 3 illustrates the schematic

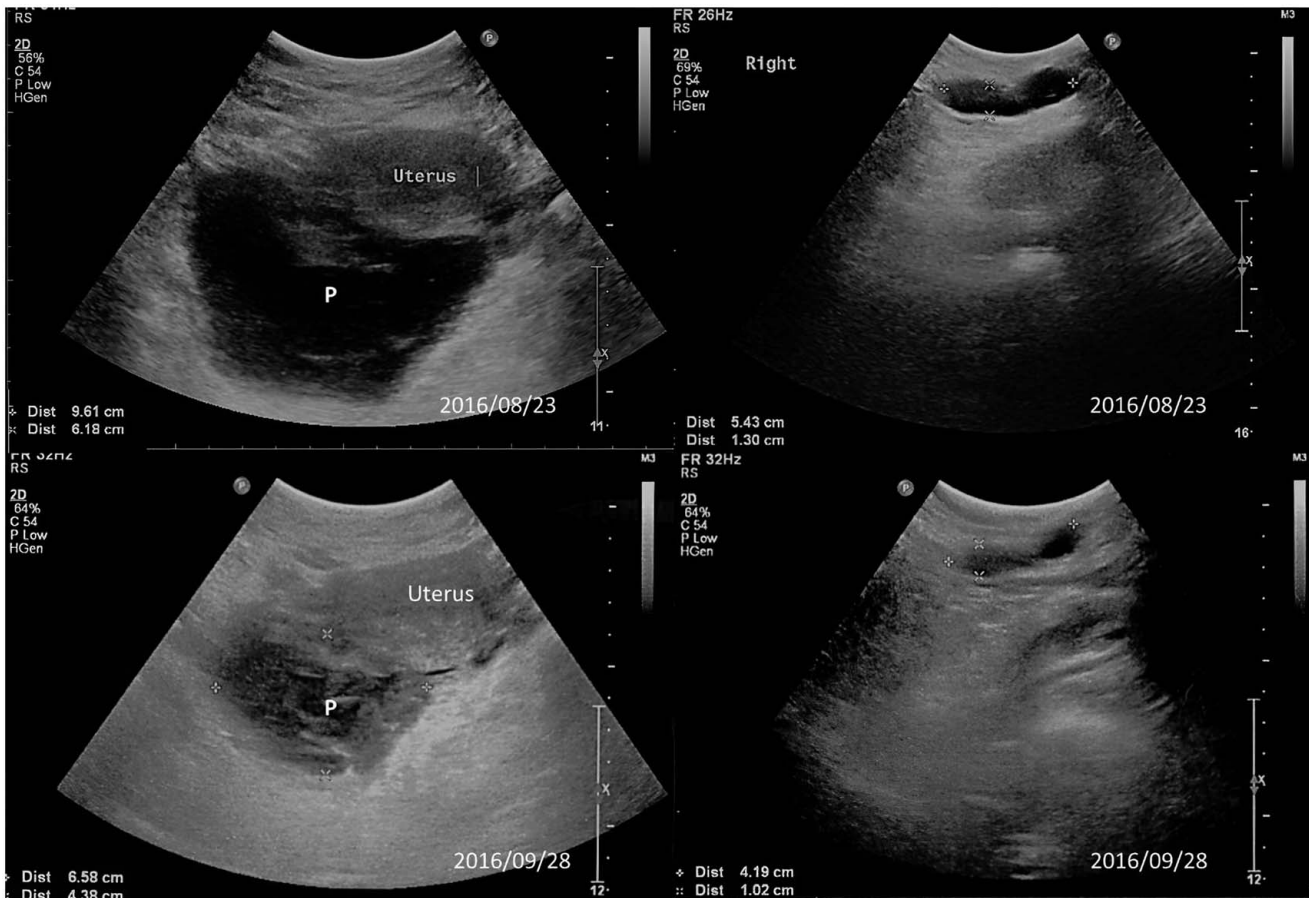


Figure 1. Postoperative transabdominal sonography on 2016/08/23 showed one 9.61 × 6.18 cm pelvic cyst (P) (Fig. 1A) with one 5.43 × 1.30 cm inguinal cyst (Fig. 1B). Sonography on 2016/09/28 showed pelvic cyst (P) 6.58 × 4.38 cm (Fig. 1C) and inguinal cyst: 4.19 × 1.02 cm (Fig. 1D).

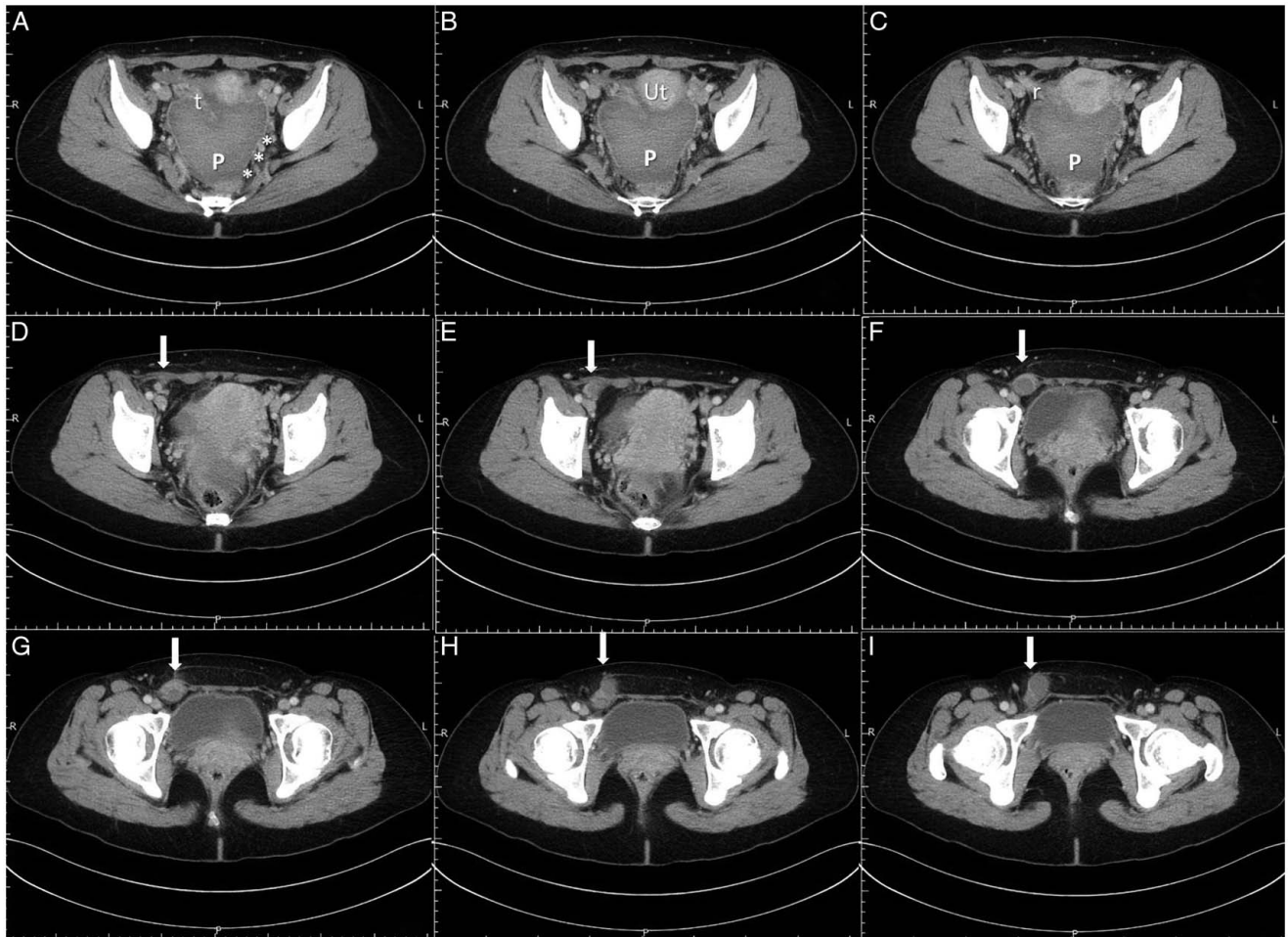


Figure 2. Pelvic computer tomography on 2016/08/23 showed a right inguinal hernia without bowel incarceration. *: ADEPT appears hyperdensity line with hypodensity fluid during computer tomography; P: pelvic cyst.

diagram. Here, the right inguinal hernia may have developed due to the movement of the non-resorbed anti-adhesive fluid from the peritoneal cavity into the hernia sac through this small congenital

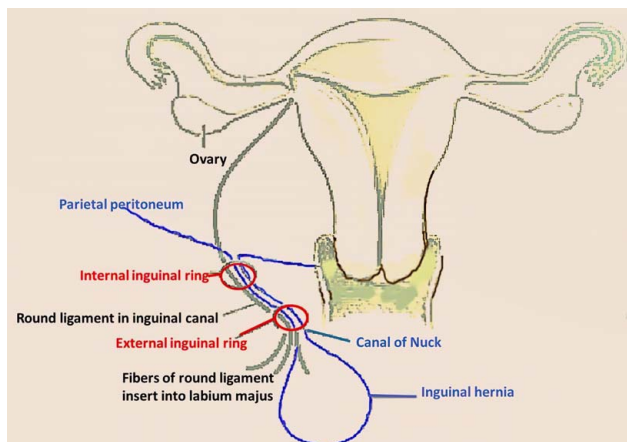


Figure 3. Schematic diagram illustrates the indirect inguinal hernia showing the canal of Nuck and round ligament.

defect resulting from high abdominal pressure. Inguinal hernia development in patients with new-onset ascites involving a similar underlying mechanism was reported^[8,9]. Inguinal hernia may contain peritoneal fluid and occur in the omentum, intestine, ovary, and, rarely, the uterus^[10–12]. Such patients are more likely to present a painful, irreducible mass, as observed in our case. High-frequency ultrasonography is the standard imaging modality to confirm inguinal hernia, its contents, and to detect ischaemia. Early surgical repair is recommended in irreducible hernias with ischaemia.

ADEPT is an anti-adhesive solution comprising 4% icodextrin, a biodegradable, alpha-1,4-linked, starch-derived glucose polymer. It typically remains as a reservoir in the peritoneal cavity for 3–4 days; however, in our case, it remained for 9 months. ADEPT is transferred into the systemic circulation by peritoneal lymphatic drainage, metabolized in the blood by amylase into oligosaccharides, and eliminated by renal excretion^[13].

This case presented no known risk factors for inguinal hernia. ADEPT was suspected of causing the right inguinal hernia as it was used as an irrigating fluid and a post-operative instillate that remained in the peritoneal cavity. A possible explanation might be an increase in abdominal pressure, similar to how ascites causes hernias^[8]. To prevent adhesion formation, ADEPT

suggests instilling 1000 ml into the peritoneal cavity to remain as a postoperative instillate^[14]. However, it might lead to a longer increased intra-abdominal pressure. ADEPT appears as a hyperdense line with hypodense fluid on computed tomography scans; moreover, its deposition on the damaged peritoneal surfaces provides temporary separation during the initial 24–96 h, a critical time when permanent fibrous adhesion may occur^[15].

Common ADEPT-associated adverse events include post-operative pain, headache, nausea, leakage from port sites, dysmenorrhoea, constipation, and pelvic pain. Labial/vulvar swelling has been observed more often in the ADEPT group compared with that in the lactated Ringer's solution group (6% vs. 0.4%; $P=0.002$)^[14]. Rare complications, such as ileus, abdominal distention/discomfort, and pelvic collections, have also been reported^[13,14,16]. Doumplis *et al.*^[17] reported five cases with adverse effects with the use of ADEPT (two cases of labial swelling, two of pleural effusion, and one of anaphylactic reaction); however, once the fluid was absorbed and metabolized on the third or fourth post-operative day, all the patients showed improvement of their condition. Rhonhe *et al.*^[16] reported three cases of hydrothorax, which spontaneously resolved. Santos *et al.*^[18] reported a rare case of suspected ADEPT-related disseminated intravascular coagulation status post-laparoscopic myomectomy. Despite these ADEPT-associated complications, no cases of ADEPT-induced inguinal hernia, as seen in our case, have been reported to date.

ADEPT-related inguinal hernia can be prevented by several ways. Excessive intra-abdominal pressure should be avoided to prevent the migration of peritoneal fluid through small orifices to areas of lower pressures. External pressure can be applied over the groins (superficial/deep inguinal rings) until CO₂ is removed from the abdominal cavity. To prevent hydrothorax, place the patient in the head-down position before instilling ADEPT to avoid fluid migration through orifices in the diaphragm near the aortic opening into the chest cavity. Finally, patients with known allergies, especially to starch-based polymers, or those with maltose or isomaltose intolerance, should refrain from using ADEPT. There are many anti-adhesive agents on the market. We recommend adjusting the selection of anti-adhesion products based on the individual conditions of each patient.

The strength of this study lies in its rarity, and we have proposed several strategies for preventing this complication. However, a limitation of our study is the requirement for additional evidence and experience to effectively manage such complications. Specific guidelines to manage the complications arising from the use of ADEPT should be developed, based on more evidence and experience with the product.

Conclusion

Inguinal hernia is a rare anti-adhesion solution complication in females. While surgical treatment is an option, conservative treatment might also resolve the problem. Avoiding excessive intra-abdominal pressure and applying external pressure over the superficial/deep inguinal rings can help decrease the risk of hernia when using the anti-adhesion solution.

Ethical approval

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Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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Author contribution

M.-J.C. wrote the manuscript. P.-S.H. reviewed the literature and contributed to manuscript drafting. All authors approved the final version of the manuscript to be submitted.

Conflicts of interest disclosure

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All data were available.

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References

- [1] Sohrabi C, Mathew G, Maria N, *et al.* The SCARE 2023 guideline: updating consensus Surgical CAse REport (SCARE) guidelines. *Int J Surg* 2023;109:1136–40.
- [2] Brüggmann D, Tchartchian G, Wallwiener M, *et al.* Intra-abdominal adhesions: definition, origin, significance in surgical practice, and treatment options. *Dtsch Arztebl Int* 2010;107:769–75.
- [3] González-Quintero VH, Cruz-Pachano FE. Preventing adhesions in obstetric and gynecologic surgical procedures. *Rev Obstet Gynecol* 2009; 2:38–45.

- [4] Ramanan B, Maloley BJ, Fitzgibbons RJ Jr. Inguinal hernia: follow or repair? *Adv Surg* 2014;48:1–11.
- [5] Lee SY, Koo YJ, Lee DH. Classification of endometriosis. *Yeungnam Univ J Med* 2021;38:10–8.
- [6] Hegazy A, Hegazy A. *Clinical embryology for medical students and postgraduate doctors*. Lap Lambert Academic Publishing; 2014.
- [7] Patel B, Zivin S, Panchal N, *et al*. Sonography of female genital hernias presenting as labia majora masses. *J Ultrasound Med* 2014;33:155–9.
- [8] Zeitler MR, Wouk N. Incarcerated inguinal hernia as a complication of new-onset ascites. *BMJ Case Rep* 2017;2017:bcr-2017-219613.
- [9] Sugarbaker PH. Management of an inguinal hernia in patients with pseudomyxoma peritonei. *Eur J Surg Oncol* 2017;43:1083–7.
- [10] Ming YC, Luo CC, Chao HC, *et al*. Inguinal hernia containing uterus and uterine adnexa in female infants: report of two cases. *Pediatr Neonatol* 2011;52:103–5.
- [11] George EK, Oudesluys-Murphy AM, Madern GC, *et al*. Inguinal hernias containing the uterus, fallopian tube, and ovary in premature female infants. *J Pediatr* 2000;136:696–8.
- [12] Artas H, Gurbuzer N. Inguinal hernia containing both ovaries and the uterus in an infant. *J Ultrasound Med* 2012;31:1138–9.
- [13] Hosie K, Gilbert JA, Kerr D, *et al*. Fluid dynamics in man of an intra-peritoneal drug delivery solution: 4% icodextrin. *Drug Deliv* 2001;8:9–12.
- [14] Brown CB, Luciano AA, Martin D, *et al*. Adept (icodextrin 4% solution) reduces adhesions after laparoscopic surgery for adhesiolysis: a double-blind, randomized, controlled study. *Fertil Steril* 2007;88:1413–26.
- [15] diZerega GS, Verco SJ, Young P, *et al*. A randomized, controlled pilot study of the safety and efficacy of 4% icodextrin solution in the reduction of adhesions following laparoscopic gynaecological surgery. *Hum Reprod* 2002;17:1031–8.
- [16] Ronghe R, Bjornsson S, Hannah P. Pleural effusion following use of saline and fluid anti-adhesion agents at laparoscopic surgery—a case series of three patients. *Bjog* 2009;116:1524–6.
- [17] Doumplis D, Majeed G, Sieunarine K, *et al*. Adverse effects related to icodextrin 4%. Our experience. *Gynecol Surg*. 2007;4:1613–2076. *Gynecol Surg* 2007;4:1613–2076.
- [18] Santos LM, Frenna V, Thoma V, *et al*. Disseminated intravascular coagulation after laparoscopic multiple myomectomy with use of icodextrin: a case report. *J Minim Invasive Gynecol* 2006;13:480–2.