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Utilization of a Porcine Xenograft for the Treatment of Chronic Pelvic Pain Secondary to Post-Cesarean Adhesions: A Case Report

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Abstract

Post-surgical adhesions are unavoidable and can lead to significant sequelae following abdominal surgeries, including Cesarean deliveries. These adhesions pose several risks to the patient, including secondary infertility, severe pelvic and abdominal pain, and bowel obstructions. Although strategies to limit adhesion formation, such as peritoneal closure and the application of adhesion-prevention barriers, are commonly employed, the available interventions beyond these measures remain limited. In this case, a 32-year-old female failed conventional adhesion-prevention and treatment strategies, necessitating a novel approach using porcine urinary bladder extracellular matrix (ACell, Inc.) as a re-adhesion barrier. Given the predominant use of porcine xenografts as a biological mesh in hernia repairs, there is minimal literature describing their potential role in adhesion prevention. This case demonstrates a novel application of a porcine xenograft and may open the door to new treatment options for refractory adhesions. Further studies to establish the efficacy of xenografts as adhesion-prevention barriers are needed to inform guidelines for their use in surgical interventions.

Keywords

Xenograft, Post-Operative Complications, Laparoscopic, Adhesions, Cesarean, Porcine

1. Introduction

Cesarean section is a surgical alternative to vaginal delivery and is among the most performed operations worldwide, with rates continuing to rise each year [1] [2].

One of the most common post-operative complications of Cesarean deliveries is intraperitoneal adhesions [3] [4]. Adhesions often lead to significant patient morbidity, including chronic pelvic and abdominal pain, bowel obstruction, subfertility, prolonged delivery time in subsequent Cesarean deliveries, and require additional procedures for adhesion lysis [5]. Post-Cesarean adhesions result in substantial emotional, physical, and financial burdens for patients, leading to a reduction in quality of life. The rate of adhesion development is estimated at approximately 50% of women following their first Cesarean delivery [4] [6]. Furthermore, the incidence and severity of adhesions rise with each subsequent Cesarean delivery [6]-[8]. There is variability in the degree of pelvic pain associated with abdominal adhesions, ranging from asymptomatic to debilitating. A pain mapping study showed that adhesions that allow for movement between intra-abdominal structures, such as the ovaries or bladder, and the peritoneum, had the highest pain association [9].

As Cesarean delivery rates continue to escalate, advancing and refining adhesion-prevention techniques has become increasingly critical to minimizing the morbidity of post-Cesarean adhesions. In this case report, we present a patient with severe, refractory abdominal adhesions secondary to Cesarean delivery with debilitating pelvic pain. We demonstrate the usefulness of a porcine xenograft in the prevention of re-adhesion following surgical adhesiolysis with subsequent relief of pelvic pain, fertility resumption, and improved quality of life.

2. Case Description

A 32-year-old G1P1001 female with a history of Cesarean delivery, with a Pfannenstiel incision, presented two years later for a follow-up with a two-month history of severe lower abdominal and pelvic pain. One month before the onset of symptoms, the patient was instructed to discontinue oral contraceptive use due to an increased risk for ischemic stroke, given recurrent migraines with auras. She had no other relevant medical or surgical history. Following the discontinuation of her oral contraceptives, the patient developed heavy menstrual bleeding and severe episodes of lower abdominal and pelvic pain. Before initiating oral contraceptives, her menstrual cycles were regular, occurring monthly with mild dysmenorrhea. The pain worsened with lifting heavy objects, straining, laughing, and intercourse. Speculum examination was unremarkable, with no cervical motion tenderness, and bimanual examination revealed general discomfort without localized pain. Transvaginal ultrasound found no masses, cysts, or obvious structural causes of her pain. Additionally, she denied any urinary or gastrointestinal symptoms. Initial attempts to control the pain pharmacologically with acetaminophen with codeine 300/30 mg and tramadol 50 mg as needed were unsuccessful. Given the strong clinical suspicion for post-Cesarean adhesions, possible endometriosis, and the patient's expressed desire to maintain fertility, it was determined that the patient should undergo a diagnostic laparoscopy with possible adhesion lysis.

Laparoscopic findings included dense uterine, bowel, and omental adhesions to

the anterior abdominal wall (**Figure 1(A)**). No endometriotic implants were noted during this procedure. Trocars were placed in the right and left lower quadrants, through which a Harmonic Ace was inserted to lyse extensive adhesions between the uterine and abdominal walls, restoring uterine mobility (**Figure 1(B)**). Next, the focus was shifted to the omental and bowel adhesions in the right lower quadrant. These adhesions were partially lysed using the same method; however, some adhesions were left intact, given their involvement with the bowel and risk for perforation. An Interceed® adhesion barrier (Gynecare) was placed to prevent adhesions from reforming before removing instruments and closing laparoscopic entry points.

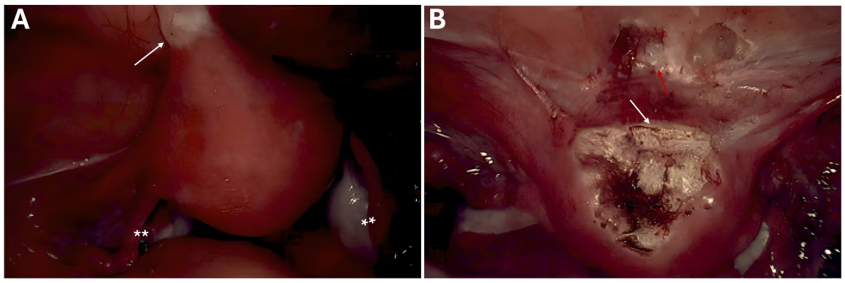

Figure 1. Initial adhesiolysis. (A) Adhesion between the uterine fundus and the anterior abdominal wall (white arrow). Bilateral fallopian tubes and ovaries are within the field of view (white **). (B) Post-adhesion lysis showing the denuded uterine fundus (white arrow) freed from the anterior abdominal wall (red arrow).

Two months following the initial lysis, the patient's pain returned and was worse than before the adhesion lysis. Again, the pain was inadequately controlled with pharmacotherapy, including Hydrocodone/Acetaminophen (Norco) 10/325 mg as needed. Pelvic magnetic resonance imaging (MRI) was obtained to evaluate for recurrent adhesions and to guide surgical planning prior to repeat laparoscopy [10]. It demonstrated deformation of the uterine surface and band-like, low-signal-intensity densities extending from the uterus to the anterior abdominal wall, findings suspicious for fibrous adhesions and suggestive of adhesion barrier failure. We proposed to the patient that she could undergo a DaVinci® robotic surgery to lyse the adhesions and to place a porcine xenograft as a novel adhesion barrier. Porcine xenograft, a porcine urinary bladder extracellular matrix (ACell, Inc.), is a membrane derived from porcine bladder after cells have been removed. After extensive counseling on the risks of using a xenograft, including infection, inflammation, graft rejection, and the need for long-term monitoring, the patient agreed. The robotic procedure revealed dense adhesions between the lower uterine segment and the abdominal wall, between the mid-one-third of the left fallopian tube and the pelvic sidewall, and between the sigmoid colon and the pelvic sidewall. No endometriotic implants were noted. The dense adhesions between the uterus and the abdominal wall were completely lysed, again allowing the uterus to become mobile. The sigmoid colon was carefully freed of adhesions, and the remaining omental and bowel adhesions appeared similar to those of the previous lapa-

roscopy. Two grafts were made by cutting a 7 × 5 cm porcine xenograft and secured using 3-0 Vicryl® on an RB-1 needle. One piece was placed on the denuded serosal surface of the uterus and anchored with two sutures per side. The other piece was placed on the denuded area of the abdominal wall with three sutures per side. Both graft pieces were positioned so that their basement membrane sides faced each other (Figure 2). Seprafilm® (Baxter) in 60 mL of saline was placed at the junction of the uterus and abdominal wall. Her post-operative course was uncomplicated.

A second-look laparoscopy was planned four months later to evaluate the success of the xenograft.

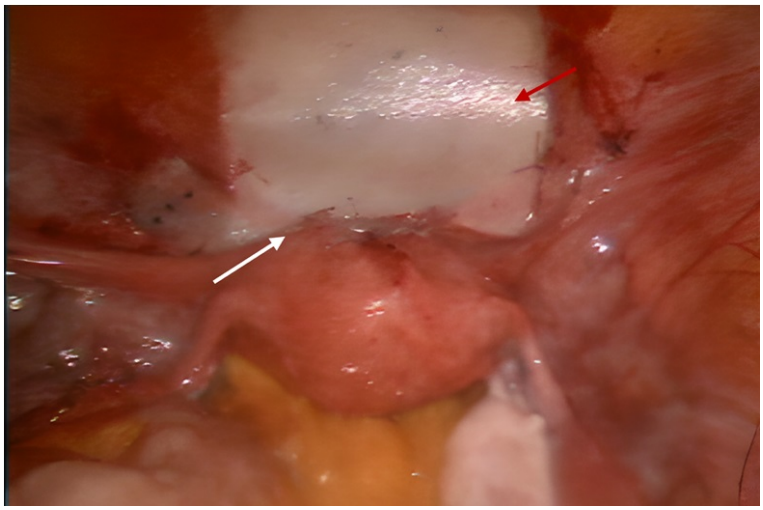

Figure 2. Porcine xenograft placement. A 7 × 5 cm porcine xenograft was cut into two pieces, one secured to the anterior fundus (white arrow) and the larger piece placed on the abdominal wall (red arrow).

Two months after the placement of the xenograft, the patient showed significant improvement in her pain and was able to wean off narcotics, but still had some pelvic pain that was relieved with 800 mg of Ibuprofen each day. Two weeks before her scheduled second look and approximately four months after the xenograft placement, she began experiencing pain similar to but less frequent than before the xenograft placement. The second look laparoscopy revealed a minor adhesion between the omentum and the apex of the two xenografts (Figure 3(A)). The adhesion was then lysed and cauterized, freeing the omentum. This adhesion was attributed to exposed sutures at the apex of the two porcine xenografts, rather than graft failure. One endometriotic implant was observed near the mid-third of the left round ligament and was fulgurated (Figure 3(C)). Further inspection of the xenografts confirmed two shimmering, white, healthy-appearing grafts without adhesions between them (Figure 3(B)). The procedure was finished and closed. She had an uneventful, complication-free post-operative course and had no graft-related complications.

The third adhesion lysis was successful, with remission of pain requiring nar-

cotics for pain relief. Four months after her second look laparoscopy, she only had occasional pelvic pain relieved by acetaminophen, and she stated this was the first time she had felt "normal" in a long time. Additionally, fertility was preserved per the patient's wishes. The patient was able to conceive seven months following the operation and deliver via elective Cesarean at full term.

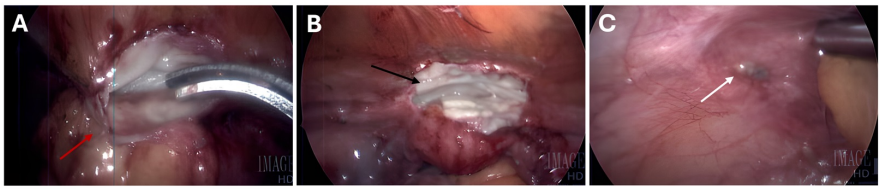

Figure 3. Second-look laparoscopy. (A) Adhesion between the apex of the xenograft and omentum (red arrow). (B) Healthy appearing xenograft without sign of adhesion (black arrow). (C) Small endometriotic implant near the mid-third of the left round ligament (white arrow) surrounded by healthy tissue.

3. Discussion

In this case report, we demonstrate a novel application of porcine xenograft in the treatment of chronic pelvic pain secondary to peritoneal adhesions following Cesarean delivery. To our knowledge, it is the first description of this technique for the treatment of post-Cesarean adhesions, demonstrating long-term pain relief. Notably, the xenograft did not impair the patient's ability to conceive and carry a term pregnancy, an outcome that was particularly important to the patient. It is important to note that, despite multiple extensive adhesiolysis procedures, some omental and bowel adhesions persisted, and an endometriotic implant was identified on her third procedure, both of which may contribute to ongoing or recurring symptoms. Additionally, Seprafilm® was applied concurrently with the xenograft during the same operation. While the xenograft was selected due to prior failure of standard adhesion barriers in this patient with refractory adhesive disease, the combined use of Seprafilm® may have contributed to the prevention of symptom recurrence. We would like to emphasize that informed consent and careful post-operative monitoring were essential in this case to ensure there were no graft-related complications, including immunogenic reactions, infection, and long-term safety.

Treatment of adhesions is usually surgical, often laparoscopically. Surgical adhesion lysis is commonly employed, and though it can restore fertility [11], there is limited data to support its effectiveness in pain reduction. Despite several interventions aimed at preventing adhesion formations, few demonstrate substantial evidence to support their efficacy in reducing pelvic pain and secondary infertility [11]. Current preventative measures include specific surgical techniques aimed at reducing operative tissue trauma and inflammation [11] [12], closure of the parietal peritoneum, and implementation of various anti-adhesion agents. While it has been hypothesized that closure of the parietal peritoneum reduces adhesion formation, many conflicting studies make it difficult to determine if such a benefit

exists [7] [13] [14]. Commonly used anti-adhesion agents include oxidized regenerated cellulose (Interceed®), sodium hyaluronate and carboxymethylcellulose (Seprafilm®), polyethylene glycol gels (Spraygel™, COSEAL®), and 4% icodextran (ADEPT®) [5] [11]. Interceed® and Seprafilm® are absorbable solid agents that act as mechanical barriers to prevent contact between the peritoneum and intra-abdominal organs [11]. ADEPT®, Spraygel™, and COSEAL® are absorbable liquid/gel agents that are thought to stay in the peritoneal cavity for several days and coat surfaces, preventing contact between denuded tissues [11]. Each type of anti-adhesion agent has its own advantages and disadvantages, with specific clinical indications where the evidence may more strongly support its use [15]. Robust data supporting the effectiveness of anti-adhesion agents is limited, especially regarding the outcomes of improved quality of life, pelvic pain reduction, and fertility in Cesarean-related adhesive disease [11] [16]. Notably, an expert panel of obstetricians recently agreed on their usefulness in patients undergoing a first Cesarean section and younger patients interested in preserving future fertility [5].

In contrast to these traditional inert anti-adhesion agents, the porcine urinary bladder matrix xenograft functions as a scaffold, allowing the host's cells to fill in and form a new serosa [17]. The scaffolding properties of porcine urinary bladder extracellular matrix have traditionally been applied to promote tissue repair and regeneration in applications across surgical specialties [17]. Currently, porcine xenografts are best known for their use as a biological surgical mesh in abdominal wall reconstructions and hernia repairs. They also serve an additional role as porcine small intestinal submucosa (SIS), an absorbable extracellular matrix, useful for coaxing chronic wounds and poorly healing wounds into the healing process. Their potential application in gynecologic surgery remains largely unexplored and represents an area of possible clinical utility. Biological mesh has been shown to reduce adhesion formation in multiple animal models for hernia repair [18]. Currently, more clinical studies are needed to investigate the rate of adhesion-related complications following biological mesh implementation and to determine whether animal data can be clinically translated. Given that adhesion formation occurs through a series of inflammatory reactions in response to local tissue damage, it is logical for a xenograft to assert anti-adhesive properties. Xenografts mimic native tissue, thus reducing the overall inflammatory response [17]. At a mechanistic level, extracellular matrix-based scaffolds may mitigate adhesion formation by modulating the early inflammatory response that drives fibrotic scar formation, the underlying basis of intraperitoneal adhesions [19]. By limiting fibroblast overactivation and fibrin deposition, these scaffolds may facilitate mesothelial cell migration and promote reepithelialization of injured peritoneal surfaces [20]. Immunogenicity of xenografts is prevented through the preparation of the graft. Most xenografts go through a series of steps, including decellularization, crosslinking, and sterilization, to leave behind a strong extracellular matrix [17]. An additional property of the xenograft that may confer adhesion prevention capabilities is simply its role as a physical barrier between intraperitoneal surfaces.

Once covered by the xenograft, the wounded surface is no longer able to come into contact with other intraperitoneal surfaces, preventing the nidus for adhesion. Currently known adverse outcomes involving xenografts and biological meshes, similar to those seen with synthetic mesh, including pain, infection, mesh erosion, and rare cases of rejection, have been reported and must be discussed in detail with patients as part of the informed consent discussion [18].

4. Conclusions

We would like to recognize several important limitations in this report. Its generalizability is inherently limited by its being a single-patient experience. The use of Seprafilm® with the xenograft makes it difficult to attribute independent effects of the porcine urinary bladder extracellular matrix. Additionally, the suture-related omental adhesion and incidental finding of endometriosis in the third procedure further complicates the interpretation, as both likely contributed to the symptomatology and outcomes. Given these limitations, the observed outcome should be interpreted as a single clinical observation. Nevertheless, this case highlights a potential role for alternative biologic materials in patients with refractory adhesive disease.

This case describes the use of porcine urinary bladder extracellular matrix in the treatment of chronic pelvic pain attributed to post-Cesarean adhesions. Given that the existing literature on biologically active scaffolds in gynecologic surgery is limited, this gap underscores the relevance of the present case. There is a lack of data evaluating their use for adhesion prevention in patients with refractory adhesive disease in direct comparison to standard adhesion barriers. The favorable outcome observed in this case should therefore be considered hypothesis-generating, and further studies are needed to better define the safety and potential role of porcine xenografts in the prevention and management of intraperitoneal adhesions in gynecologic surgery.

Ethics Statement

The publication of this case report was conducted in accordance with the guidelines set forth by the Texas Tech University Health Sciences Center Institutional Review Board and was approved.

Authors' Contributions

J.C.H. was the clinician who cared for the patient, contributed to the report's conception, and reviewed the manuscript. B.Y.S. contributed to the report's conception, drafting, and manuscript review. K.S.F. contributed to the report's conception, drafted the manuscript, and created the figures. M.L. and K.S. contributed to the drafting and reviewing of the manuscript. K.A. assisted in manuscript review.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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