

Beyond the caesarean scar: A narrative review on isthmocele and its prevalence, etiology, pathology, clinical consequences, histopathology, management, and management outcomes

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Abstract

With the increase in rates of caesarean section worldwide, development of isthmocele, also referred to as cesarean scar defect or niche, is increasingly recognized as one of the late complications giving rise to clinical consequences. It is associated with obstetric and gynecological problems including placenta previa, placenta accreta, pregnancy implantation at the level of the scar and uterine rupture in subsequent pregnancies, abnormal uterine bleeding, pelvic pain, subfertility, and adverse obstetric outcomes^{1,2}.

Various treatment strategies have developed for the management of isthmocele due to its clinical relevance and complications. This narrative review focuses on summarizing evidence published between 2015 and 2025 regarding clinical symptomatology, etiology, pathology, management and management outcomes of isthmocele, along with current gaps in evidence.

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Introduction

Isthmocele is an incompletely healed cesarian section scar resulting in a pouch-like defect in the anterior uterine wall located at the site of the previous cesarian scar.

This was first reported in 2001^{2,3,4,5} mentioned as a triangular anechoic filling defect commonly occurring after multiple cesarian deliveries^{3,5}. With routine evaluation this has been increasingly reported. Definition of isthmocele was controversial, where depth of 1mm was taken as the cut off in most of the previous studies⁶, 2mm in a Delphi study done in 2019⁷ implying an important contribution to reduce the possible false positive rates caused by minor scar irregularities, physiological healing changes and measurement artefacts.

Although no diagnostic method has been considered as a universal gold standard for detection of isthmocele, in 2019 gel or saline sonography was found to be a useful adjunct to transvaginal ultrasonography⁷. Two structural components of a niche were identified as the defect represented by hypoechoic, and a pouch made of scar fibrotic tissue within the myometrium².

Prevalence of isthmocele varies in a huge range based on mode of diagnosis. Most of the isthmoceles are asymptomatic, although larger defects are more likely to give rise to complications.

Presumed causes include surgical procedure related factors, patient related factors, repeated cesarian sections, labor related factors, infection and inflammation.

Surgical correction has been effective in symptomatic women particularly in those expecting fertility.

Prevalence

Literature around 2010's, particularly before 2019, have taken 1mm depth for the definition of uterine niche with a significant variation in prevalence noted with different imaging modalities. 24.0% and 56.0% 225 women 6 to 12 months postpartum were diagnosed to have isthmocele by transvaginal ultrasound scan and gel instillation sonography, respectively⁸. Combined evaluation with transvaginal ultrasound scan (TVUS), Magnetic resonance Imaging (MRI), diagnostic hysteroscopy revealed high prevalence of 63.3%⁹.

Many studies done after 2019, have taken at least 2mm depth for the diagnosis of isthmocele. According to evidence from a study conducted among 6 weeks to 6 months postpartum women who have undergone Lower Segment Cesarean Section (LSCS), prevalence of isthmocele was 30% when using TVUS and SIS in which isthmocele parameters were agreed upon similar limits¹⁰, in Brazil with TVUS it was 41.19% in women with a history of at least one LSCS done more than 6 months ago¹¹. But in a study done in 2022 to 2023 in Romania prevalence was noted as 42.3% with a maximum depth of 1.01 cm¹².

Diagnosis of isthmocele lacks uniform criteria, thereby influencing the reported prevalence. However, prevalence of isthmocele in Sri Lanka is yet to be evaluated.

Etiology

Cesarian scar defect can be due to different etiologies such as surgery-related factors, patient related factors and others.

These include,

- Poor surgical techniques.
- Lower uterine incision applied closer to the cervix.
- Excessive use of diathermy leading to excessive tissue necrosis.
- Interlocking sutures used to achieve hemostasis.
- Associated with advanced cesarian section/emergency cesarian section rather than elective.
- Uterine artery blood flow resistance

Surgery related factors has a major role in the occurrence of isthmocele. Usage of catgut for LSCS suturing was found to have higher risk of isthmocele compared to vicryl¹³ while usage of locking continuous suture for the first layer were more likely to give rise to severe scar defects but with a p value of 0.056¹². Types of sutures that reduce the risk of scar defect occurrence is yet to be found. Duration of surgery was also significantly associated¹⁰. Although women who have received single layered sutures constituted a larger population with isthmocele compared to ones without isthmocele, this change was not statistically significant¹². Even for the severity, number of layers had not shown a significant difference¹².

Patient related factors include factors that contribute to poor healing such as, anemia, diabetes mellitus and a history of multiple LSCS. Prevalence of isthmocele was reported to increase with the number of previous LSCS^{10,11,12,14,15}. And odds of women who have undergone elective cesarian section developing an isthmocele was low¹⁵. Characteristics of the previous cesarian scar has also shown a significant association¹⁰.

Also, advanced maternal age^{11,15}, unit increase in BMI^{10,15} and asthma were found to be associated with the development of isthmocele with a 20%, 156%,

28% higher odds of having isthmocele, respectively¹⁵. Premature rupture of membranes and pre-eclampsia were reported to be significantly linked to cesarean scar defect.

Pathophysiology

The resulting niche forms a pouch-like defect that disrupts normal uterine contractility and peristalsis, promoting retention of menstrual blood within the scar. This retained blood gradually drains after menstruation, causing postmenstrual spotting and chronic inflammation. Altered local vascularity and

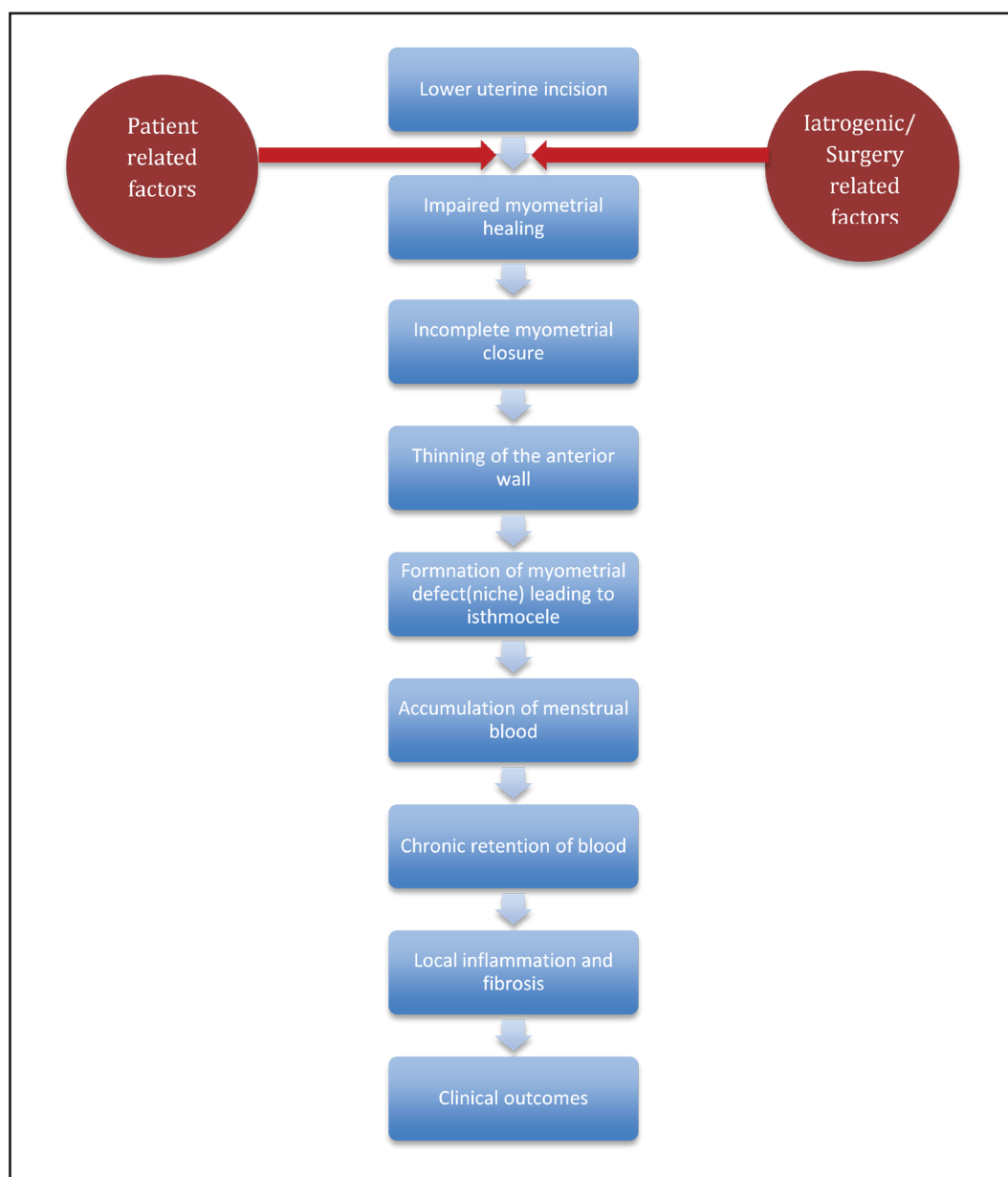


Figure 1. Estimated average monthly search volume by retained keyword.

fibrosis further perpetuate poor scar remodeling. In women desiring fertility, persistent intracavitary fluid, local inflammatory changes, and reduced endometrial receptivity near the scar are thought to impair sperm transport and implantation, explaining the association between isthmocele, abnormal uterine bleeding, and secondary infertility.

Symptoms associated with isthmocele

Most women with isthmocele remain unnoticed without follow-up TVUS because most of them are asymptomatic. However, some develop symptoms, predominantly menstrual symptoms in around 34% including menstrual irregularities, abnormal vaginal bleeding, post menstrual spotting, dysmenorrhea and chronic pelvic pain in around 19%²², also isthmocele had come to surface with secondary infertility and recurrent implantation failures. Symptoms were more likely to occur with multiple cesarean sections²².

Some studies have demonstrated a high prevalence of symptoms, which was 82.5%¹¹, among women who were diagnosed to have isthmocele by TVUS while some revealed a high prevalence of asymptomatic women with isthmoceles, about 45.8%²².

When considering abnormal uterine bleeding related to cesarean scar, phase of menstrual cycle has a vital role. Evidence have shown that TVUS conducted during luteal phase have a higher risk of missing collections within cesarean scar defects. This is due to the likelihood of abnormal uterine bleeding to occur during follicular phase and ovulatory phase¹⁶ rendering fluid collections be less likely during luteal phase.

Tanimura has successfully revealed that bleeding occurs from the scar defect by using hysteroscopy¹⁷, and menstrual bleeding seems to be prolonged sometimes more than 8 days¹¹. Post menstrual spotting was also evident⁸.

There has been evidence of chronic pelvic pain among patients diagnosed with isthmocele by TVUS^{16,23}.

Complications of isthmocele

Isthmoceles have been reported as a cause for many complications, mainly including gynecological and obstetric consequences.

Effects on IVF/fertility

Secondary infertility has been reported to vary in a range of 27.37% to 75% among women with scar defects, known to be due to reduced residual myometrial thickness, chronic inflammatory changes, and fluid accumulation. Assisted reproductive techniques are also affected¹⁸.

Effects on obstetric outcomes

Obstetric outcomes include, placenta accreta spectrum disorders, placenta previa, scar ectopic pregnancy, and subsequent pregnancy scar rupture or dehiscence.

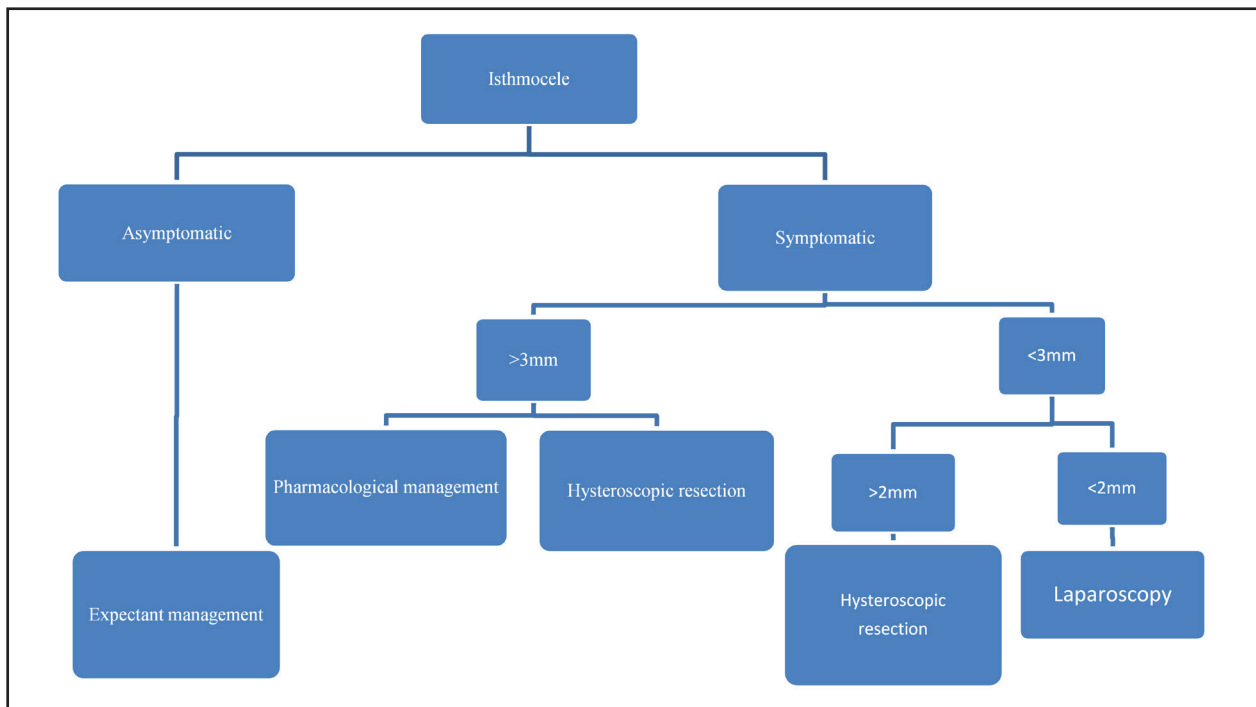
Diagnostic methods and characteristics

TVUS is considered as the first-line investigation for detection of isthmocele as it is widely available, accessible and reliable¹. Although saline contrast is preferred, it is not mandatory when intrauterine fluid is present, particularly during follicular and ovulatory phases of menstrual cycle and it is of value in endometrial evaluation⁷.

A Delphi procedure done in 2019, has recommended the best method to take measurements, stating with 100% agreement that sagittal plane should be used to measure length, depth of the defect, where it is largest and residual myometrial thickness (RMT), where it is smallest, while width to be measured in the transverse plane. Both planes are important to identify branches⁷.

Detection of a scar defect depends on the pressure generated by the transvaginal probe and the position of the defect, in which proximal defects require more pressure compared to distal defects⁷.

A cross-sectional study conducted using criteria recommended in Delphi consensus revealed that, length of the defect displayed a higher diagnostic accuracy for symptomatic patients with a cut off value of 5mm with a moderately reliable diagnostic accuracy when considering depth to adjacent myometrial thickness (AMT) with a cut off value of 0.55, depth to RMT with a cut off value of 1.22²². In symptomatic women niche length, depth to AMT ratio, depth to RMT ratio was significantly higher and RMT was lower^{11,22}. Greater niche length, depth, width was reported among those with symptoms¹¹. With repeated cesarean sections length, depth, depth to AMT ratio tend to increase while RMT was likely to reduce²².



A prospective study done among 6 weeks postpartum women revealed a mean depth of 0.55cm with a maximum depth of 1.01cm, a mean residual thickness of 0.84cm, a mean depth to total thickness ratio of 37.6% with a maximum ratio of 66% where more than 50% was taken as severe niches.

Considering the shapes, defects were more frequently triangular while 36.4% were semicircular, the rest were inclusion cysts and droplet types. Shape of the niche was not significantly different between symptomatic and asymptomatic women while the volume was found to be significantly different⁸.

Histopathology

Histological findings were found to be in line with the pathophysiology revealing an overlying attenuated endometrium consisting with irregular glandular distortions with marked thinning or absence of normal myometrial tissues, replaced by dense fibrous connective tissue. Disorganized smooth muscle fibers collagen deposition and areas of hyalinization have been observed, reflecting impaired myometrial regeneration and abnormal wound healing. Endometrial glands extending into fibrous scar niche was also observed in some patients.

Evidence for chronic inflammation inside the scar was noted with chronic inflammatory cell infiltration in

which macrophages were abundantly found together with neovascularization.

Within the scar, trapped menstrual blood, hemosiderin and hemosiderin laden macrophages were seen correlating with the manifestations of post menstrual spotting.

Above findings support the evidence to reduced tensile strength of the scar and altered uterine contractility.

Studies done regarding histopathological findings of isthmocele have found a thin endometrium on the surface of the defect, presence of congested endometrium above the scar, formation of polyps, dilation of capillaries, infiltration of lymphocytes, red blood cells in endometrial stroma and adenomyosis confined to the scar^{16,19}. While 92% had residual suture material (Study by Morris). In a study that compared histology obtained from hysterectomy and hysteroscopy samples, degenerative debris, subepithelial hemorrhages and congested capillaries was noted in hysteroscopic samples^{16,20}.

Management

Management of isthmocele depends on several factors, for once, Tx varies between symptomatic and asymptomatic women.

Below mentioned classification gives a broad idea on the management of isthmocele.

In asymptomatic women, there is no evidence for pharmacological or surgical management, particularly, to prevent overtreatment when considering risk versus benefits¹.

If patients are symptomatic hysteroscopic resection is recommended with evidence of symptom alleviation after the process^{23,24}, particularly when residual myometrial thickness is at least or more than 2 to 3 mm¹. Evidence recommends a cut off more than 3.5mm for women with a desire for a child, more than 2.5 mm otherwise^{1,16}.

Risk of uterine rupture due to thin myometrium and bladder injury are concerning factors for these limitations. In addition, age was also taken as a limiting factor for these criteria in some studies¹⁶.

In symptomatic women pharmacological management remains as a management option but improvement of clinical condition has been inconsistent? Resection of the defect is the first line for symptomatic women^{16,23} because of the safety and efficacy. Although limited evidence exists on medical management, menstrual symptoms can be treated with oral contraceptives or levonorgestrel intrauterine system¹⁶, but with the cost of secondary infertility due to ovulation suppression and the uterine defect itself.

For patients with a RMT less than 2 mm with a large niche and expectance of future pregnancy, laparoscopic isthmocele repair is a better option^{16,23}.

Assisted reproductive techniques have been used for secondary infertility in women with cesarean scar defects where invitro fertilisation¹⁶ followed by embryo transfer was attempted. Implantation failure was observed in some of these women¹⁶, thought to be because of embryotoxic intracavity fluid inside the uterus consisting of high concentrations of iron¹.

For large symptomatic scar defects in women who have completed their family's hysterectomy is the curative management²³.

Hysteroscopic resection of isthmocele

Hysteroscopic resection is removal of fibrotic tissues in the defect enabling visualization of it and the

procedure, which is minimally invasive, and has a low morbidity, is frequently reported to be effective. This involves resection of fibrotic edges of the isthmocele establishing drainage of menstrual blood and electrocauterization of fragile vessels enabling removal of inflamed congested tissues²³.

Studies have highlighted the importance of timing of menstrual cycle for this procedure which was within 14 days of menstruation¹⁶ in the proliferative stage.

Increased thickness of myometrium was noted after hysteroscopic resection in some studies although repair of the scar defect is not done¹⁶, therefore, myometrial thickness is not restored fully, in women with very thin residual myometrium. Thus, increasing the risk of uterine perforation and bladder injuries²³. To reduce risk of such complications it is recommended to use the resectoscope²³ and to avoid hysteroscopic resection when residual myometrial thickness is less than 3mm.

Laparoscopic repair of isthmocele

Myometrial thickness is restored by laparoscopic repair which excises the fibrotic scar tissue and reconstruct the uterine wall, allowing exploration of the pelvis and adhesiolysis when needed.

Localization of scar defect is done by a hysteroscopic transillumination while suturing myometrial defect by two layered sutures is done^{1,16,23} to reinforce and increase the myometrial thickness. Shortening of round ligament was done for retroflexed or straight uteri to improve wound healing^{16,23}. When endometriosis was also evident in the cavity, laparoscopic approach allowed its treatment as well¹⁶.

Significant increase in residual myometrial thickness was noted after laparoscopic repair²³.

Studies have demonstrated significant improvement in symptoms and a measurable increase in residual myometrial thickness after laparoscopic repair. Fertility outcomes appear favorable, with postoperative pregnancy rates reported between 50% and 70% in selected cohorts. Although laparoscopic repair is more invasive than hysteroscopy, it may offer superior anatomical restoration and potentially improved obstetric safety.

Vaginal approach

Vaginal repair of isthmocele is an alternative approach which is done less commonly. In this procedure incision is made on the anterior vaginal wall to completely resect large defects accessible through this route. Two layered sutures are used for reinforcement^{1,16}, with evidence of increase in residual myometrial thickness^{1,16}.

Outcomes of management

Most of the studies done in this regard point towards favorable outcome.

Resolution of symptoms-AUB

Improvement of symptoms was observed in women who underwent hysteroscopy, laparoscopy, and vaginal surgery^{1,16,23} but success rates are higher in whom underwent laparoscopy²³.

Obstetric outcomes after surgical repair

Hysteroscopic and laparoscopic procedures increase the residual myometrial thickness which will in turn improve pregnancy outcomes^{1,16,23} including miscarriages¹. But lack of evidence on vaginal approach. Laparoscopic repair reduces the risk of cesarean scar pregnancy¹ and improve uterine wall integrity in subsequent pregnancies. Nonetheless, there is insufficient high-quality evidence to conclusively determine the impact of surgery on placenta accreta spectrum disorders or uterine rupture.

Fertility outcomes after surgical repair

The recommended management for secondary infertility in women with isthmocele is repair. It is recommended to be on contraceptives for 3 months after the procedure before conception¹. Evidence suggests successful fertility outcomes in hysteroscopic and laparoscopic management where evidence for vaginal approach is insufficient¹⁶.

Complications of management

Profuse bleeding was observed intraoperatively in hysteroscopic repair¹, with evidence of uterine rupture in pregnant women following hysteroscopic repair while with no such evidence for laparoscopy¹⁶. Hematoma formation, pelvic infections and bladder injury have been reported in relation to vaginal approach (1).

Future directions and research gaps

There is a clear need for standardized diagnostic criteria, uniform outcome measures, and prospective comparative studies to determine the optimal surgical approach for different patient profiles. Future research should focus on long-term reproductive and obstetric outcomes, particularly in women undergoing laparoscopic or combined repair techniques.

Conclusion

Although isthmocele prevalence has increased with increasing rates of cesarean section with possible etiological factors including patient related factors and iatrogenic factors with most of patients remaining asymptomatic while other developing menstrual symptoms, surgical management has been effective in relieving symptoms and improving fertility outcomes in appropriately selected patients. Hysteroscopic repair offers a minimally invasive option with high rates of symptom resolution, while laparoscopic repair may be preferable for women with large defects and thin residual myometrium. Despite promising results, high-quality evidence remains limited, and further research is required to establish standardized management algorithms.

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