

Original Research

Risk Factors for Pfannenstiel Incisional Hernia Following Cesarean Delivery and Outcomes after Laparoscopic and Open Surgical Repair

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Abstract

Background: To analyse risk factors for cesarean section (CS)-induced incisional hernia in reproductive-aged women. Outcomes of minimal invasive herniorrhaphy and open technique were presented. **Methods:** Records of patients with Pfannenstiel hernia between 2010 and 2022 were reviewed. Risk factors for incisional hernia were evaluated with surgical outcomes. **Results:** 76 patients were included. Mean age was 46 ± 8.1 years. Bulging (81.5%), pain or discomfort (57.8%) and distention (31.5%) were the most common symptoms. We combined ultrasonography (90.7%) with contrasted tomography (71%) or magnetic resonance imaging (30%) for surgical planning. Risk factors were found as multiple previous CSs, local wound complications such as seroma, hematoma or abscess, body mass index >25 , smoking, pregnancy-induced diabetes mellitus, emergency CS, and inadequate surgical technique (each, $p < 0.05$). In open technique (51.3%), fascia was closed by polydioxanone suture, with onlay mesh fixation. In laparoscopic hernioplasty (48.6%), tacker was used for mesh reinforcement. There was no bowel injury. Early complications were seroma and infection ($p < 0.01$ and $p < 0.05$, respectively). Most significant late complication was recurrence (7.8%). **Conclusions:** Clinicians should be ready to encounter more reproductive aged women with incisional hernia, since worldwide CS rate continues to rise. Awareness of risk factors, imaging methods, surgical options and outcomes are of great importance.

Keywords: cesarean section; Pfannenstiel incision; incisional hernia; risk factors; laparoscopy; herniorrhaphy; surgical outcomes

1. Introduction

Cesarean section (CS) is the most common abdominal surgery worldwide since it accounts for almost one third of all births, and this rate is set to continue increasing in the next decades [1–3]. Most of the obstetricians prefer to use Pfannenstiel incision, a low transverse skin incision two finger widths above the symphysis pubis that is extended to the direction of spina iliaca anterosuperior bilaterally, for urgent or elective CSs [4]. Cesarean delivery is considered a safe procedure, but awareness of the risk of surgical complications such as postpartum bleeding, atony, infection, hematoma, ileus, endometriosis and incisional hernia is important [5].

Although there have been dramatic improvements in wound complications of laparotomy over the last two decades, fascial dehiscence and incisional hernia seem to be unavoidable in 10 to 15% of operated cases [6]. Incisional hernias can occur after any abdominal surgical procedure where the abdominal wall is incised. It occurs at or in close proximity to a surgical incision through which intestines can protrude. Surgeons are often asked to evaluate patients with incisional hernias as they can often be symptomatic to patients. The classical presentation is a bulge with a positive cough impulse at the site of the incision scar. Patients with incisional hernias are also at risk for incarceration, obstruction, or strangulation [7]. The exact patho-

physiologic mechanism for development for an incisional hernia is not clearly known. Male gender, length of fascial incision, prior laparotomies, use of corticosteroids or chemotherapy drugs, malnutrition or chronic systemic diseases such as liver or renal failure, anemia, diabetes mellitus (DM), obstructive pulmonary or cardiovascular disease are among the well-known risk factors for incisional hernia [7,8]. However, in women of childbearing age, some other factors such as improper suture technique, smoking, emergency operation, obesity and early postoperative local wound complications may increase the risk of hernia after a CS [9].

The aim of this study was to analyse the risk factors for incisional hernia after cesarean delivery. Besides, we also shared our experience in diagnosis and treatment of Pfannenstiel incision induced hernia in reproductive-aged women.

2. Methods and Patients

2.1 Study Design

After the approval of study by Ethics'Committee (University of Medipol, Medical Faculty-01.08.2023/E-10840098-772.02-4702), medical records of patients who were admitted with a diagnosis of Pfannenstiel incisional hernia following CS(s) and underwent surgery between January 2010 and December 2022 were reviewed. Patients



signed written informed consent allowing their data to be used in medical researches. Study was carried out in accordance with the declaration of Helsinki.

2.2 Participants

All women aged 18 years or older who underwent surgery for Pfannenstiel incisional hernia were included in the study. Demographics, symptoms, physical examination findings, and imaging tools used for differential diagnosis were documented. History of smoking and pre-existing conditions including wound complications, systemic diseases and utilization of drugs (if any) were interrogated. Surgical notes of previous CS(s), exact date(s) of CS(s) before the start of hernia symptoms were noted. Body mass index (BMI), abnormal peri-operative laboratory values, surgical technique for hernia repair and postoperative complications during follow-up period were also recorded. All data were recorded at Excel programme (Microsoft 2017, Chicago, IL, USA).

2.3 Exclusion Criteria

Women with incisional hernia at a site other than CS incision scar and those with history of previous laparotomies other than CS were excluded from the study. Other exclusion criteria were those aged under 18 years, patients who are lost to follow-up visits or appointments, and lastly, patients with missing information in their medical records.

2.4 Surgical Technique for CS

Standard operative technique was a low lying suprapubic Pfannenstiel's incision in the beginning of operation; and at the end, one-layer continuous suturing of uterus, leaving peritoneum open and closing fascia continuously, as described previously in the literature [10].

2.5 Statistical Analysis

Statistical analyses were calculated using SPSS 19.0 for Windows (IBM SPSS Statistics, New York, NY, USA). Descriptive statistical methods (number, mean, standard deviation, median, frequency, percentage, minimum, and maximum) were used while evaluating the study data. Categorical Fisher's exact test and continuous variable Mann-Whitney U test were used to evaluate associations among predictive variables. $p < 0.05$ value was accepted as statistically significant.

3. Results

A total of 76 patients were included in the study, and mean age was 46 ± 8.1 years. The most common symptom was bulging ($n = 62, 81.5\%, p < 0.001$) in area of Pfannenstiel incisional scar above the pubis (mostly on the right, $n = 30, 39.4\%$; on the left, $n = 26, 34.2\%$; in the middle, $n = 30, 39.4\%, p > 0.05$). The second symptom was regional pain with feeling of discomfort ($n = 44, 57.8\%, p <$

0.01). Bowel distention or gas and constipation were also seen ($n = 24, 31.5\%$ and $n = 20, 26.3\%$, respectively, each $p < 0.05$). The least common symptoms were seen in case of bowel strangulation or ileus, which is the most feared complication of all hernias; nausea, vomiting, crampy pain and fever (each, $n = 4, 5.2\%, p > 0.05$). Physical examination on these patients was done in detail to understand whether there is an acute abdomen. In patients with irreducible bowel segment in the hernia sac or in cases with elevated white blood cell (WBC) count or C-reactive protein (CRP) level, plain abdominal graphy (X-ray, $n = 6, 7.8\%, p < 0.05$) was requested to see if there is air-fluid levels. Superficial soft tissue ultrasonography (US, $n = 69, 90.7\%, p < 0.001$; Fig. 1) and pelvic or abdominal computerized tomography (CT, with contrast, $n = 54, 71\%, p < 0.001$) were the most frequently used imaging modalities. Magnetic resonance (MR, with contrast, $n = 23, 30.2\%, p < 0.01$) imaging was also performed to plan elective surgery. Regardless of the number of surgeries, average time elapsed from the last CS to the onset of first symptom was 34 months (range, 10 days–9 years), and the mean diameter of incisional hernias was 6 cm (range, 1–27 cm).

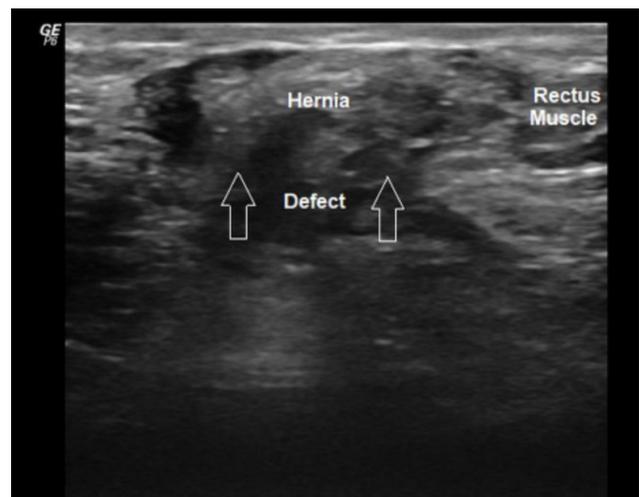


Fig. 1. Superficial soft tissue ultrasonography showing bulging in Pfannenstiel incision site.

Risk factors for incisional hernia are listed in Table 1. In patients who have had two or more CSs, the risk for Pfannenstiel hernia increased very significantly ($p < 0.01$). Similarly, wound complications such as seroma, hematoma and abscess increased the risk ($p < 0.05$). Patients' physical characteristics and habits such as overweight (BMI >25) and smoking were also among the risk factors ($p < 0.001$ and $p < 0.01$, respectively). Only systemic disorder increasing the risk of incisional hernia in our series of healthy and relatively young patients was pregnancy induced diabetes mellitus (DM, $18.4\%, p < 0.01$). Emergency CS ($p < 0.01$), recurrent disease after incisional CS hernia re-

Table 1. Evaluation of risk factors for incisional hernia.

Risk factors	Number of patients (n = 76)	Percent (% = 100%)
Previous history of cesarean section (CS) (n = 1)	9	11.8*
CSs (n = 2)	23	30.2**
CSs (n = 3)	21	27.6**
CSs (n = 4)	23	30.2**
Wound complications after CS		
Seroma	6	7.8*
Infection/abscess	12	15.7*
Hematoma	9	11.8*
Dehiscence of skin edges	1	1.3
Evisceration	1	1.3
Smoking (>10 cigarettes a day)	28	36.8**
Body mass index (BMI) underweight (<18)	3	3.9
Normal (18–25)	24	31.5
Overweight (25–30)	33	43.4***
Obese (>30)	16	21**
Other risk factors and systemic diseases		
Drugs (steroids or immunosuppressives)	1	1.3
Anemia (hemoglobin level <11 g/dL)	3	3.9
Diabetes mellitus (DM)	2	2.6
Pregnancy-induced DM	14	8.4**
Liver failure/renal failure	-	-
Chronic obstructive pulmonary disease (COPD) or chronic cough	-	-
Cardiovascular disease (CVD)****	-	-
Malignancy	-	-
Malnutrition	-	-
Anatomic or genetic diseases (thin fascia, connective tissue anomaly)	-	-
Inadequate surgical technique*****	8	10.5*
Emergency CS	15	19.7**
Recurrent disease	16	21**

* $p < 0.05$: statistically significant;

** $p < 0.01$: statistically very significant;

*** $p < 0.001$: statistically highly significant;

****Myocardial infarction, heart failure, angina pectoris or intermittent claudication;

*****Recurrence in postoperative year one in a patient with no other risk factors.

pair ($p < 0.01$), and lastly, inadequate surgical technique in herniorrhaphy ($p < 0.05$) were among the risk factors, as well.

In all emergency cases ($n = 4$, 5.2%) and in nearly half of elective patients ($n = 35$, 46%), open surgery (total $n = 39$, 51.3%) was performed depending on surgeon's preference. After dissection of fascia and reduction of hernia sac contents (mostly colon), fascial closure with continuous PDS loop (polydioxanone suture no 0 or 1, Ethicon, Somerville, NJ, USA) and onlay polypropylene mesh reinforcement were done. In laparoscopic herniorrhaphy ($n = 37$, 48.6%; Fig. 2), first trocar was inserted in upper quadrants, away from the hernia, and after taking the bowel down into the abdomen and dissection of the fascia, adjustable prolene mesh was fixed by help of tacker (Figs. 3,4). All patients were given a single dose of prophylactic antibiotic (cefazolin 1 g, iv) during induction of anesthesia. There was

no iatrogenic bowel injury in both open and laparoscopic surgeries. Postoperative recovery period was generally uneventful. Three patients (3.9%) were followed in the intensive care unit (ICU) for one night, because they needed respiratory support. There was no mortality. Patients were discharged home on postoperative day three (mean, range 1–12 days). They were routinely seen at our outpatient clinic on postoperative months 1 and 12, and at the end of the study, each of them was called by phone. Mean follow-up period after herniorrhaphy surgery was 72 months (range, 6–136 months).

Early (first month after surgery) and late postoperative complications are listed in Table 2. The most common early complications in postoperative period were surgical site seroma and infection ($p < 0.01$ and $p < 0.05$, respectively). The most significant late postoperative complication was recurrence (7.8% of patients, $p < 0.05$). Prolonged



Fig. 2. Trocar sites in laparoscopic repair.



Fig. 3. Laparoscopic view of hernial defect.

paralytic ileus which is defined as absence of bowel function for more than two days was seen only in patients who underwent open surgery ($p < 0.05$). However, chronic surgical site pain was seen only in patients who underwent laparoscopic surgery ($p < 0.05$).

4. Discussion

CS is the delivery of a fetus through an open laparotomy, most preferably from suprapubic low transverse Pfannenstiel incision, and it is now the most frequently performed surgery in the world, with more than one million operations done each year in United States alone [2,4,11]. CS rate is increasing worldwide from around 5% in 1970s to over 30% in 2018 [12]. Similarly, many recent studies have found a significant increase in both short and long term complications related to CS [13–15]. However, though there are continuing efforts to reduce the rate of CSs, experts do not anticipate a significant decrease for at least two or three decades [16]. Moreover, according to the World Health Organization (WHO)'s latest research, CSs now outnumber the vaginal deliveries in Dominic, Brasil, Egypt and Turkey, and this rate reaches the highest figure (almost 60%) in Cyprus [17]. As with any abdominal surgery, there are a number of risks or complications associated with cesarean delivery, such as atony, bleeding, infection, thromboemboli, endometriosis and incisional hernia [5,14,18].

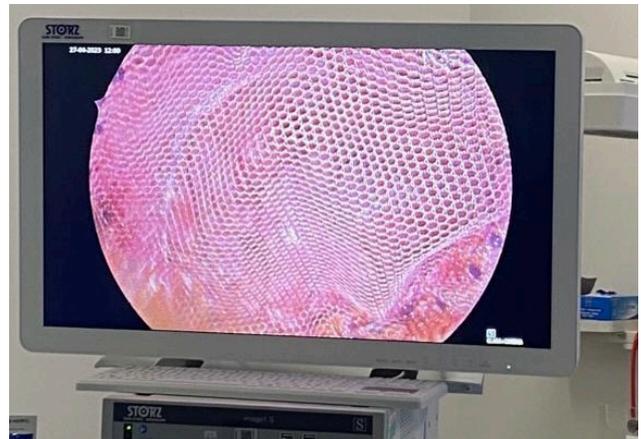


Fig. 4. Laparoscopic view of mesh repair.

Although there are many publications on the more common complications of CS, scientific research on Pfannenstiel incisional hernia, its underlying causes and outcomes of herniorrhaphy is very scarce [19,20]. Incisional hernia is one of the long-term complications of abdominal surgery, with an incidence of 3 to 30% in association with a midline incision and 0 to 5% with a transverse incision [21]. The risk increases in longer operations with wide incisions of malnourished older male patients, and in patients taking immunosuppressive agents or those with chronic sys-

Table 2. Early and late postoperative complications after incisional herniorraphy surgery.

Complications	Number of patients	Percent
	(n = 76, O/L)	(100%)
Early		
Bowel injury (need for raphy)	-	-
Bowel injury (need for ostomy)	-	-
Prolonged paralytic ileus (>2 days)	9 (9†/0)	11.8*†
Mechanical ileus (need for re-operation)	-	-
Seroma	17 (10/7)	22.3**
Bleeding/hematoma	3 (2/1)	3.9
Infection/abscess (surgical site or mesh)	8 (4/4)	10.5*
Dehiscence of skin edges	3 (1/2)	3.9
Early evisceration	-	-
Cardiopulmonary (mild)	4 (2/2)	5.2
Cardiopulmonary (severe)	-	-
Late		
Infection/abscess (surgical site or mesh)	3 (2/1)	3.9
Late evisceration (>postoperative month 1)	-	-
Mesh migration or erosion	-	-
Mechanical ileus (brid, adhesion)	4 (3/1)	5.2
Chronic surgical site pain	8 (0/8††)	10.5*††
Recurrence of incisional hernia	6 (3/3)	7.8*

O, open surgery; L, laparoscopic surgery.

* $p < 0.05$: statistically significant;

** $p < 0.01$: statistically very significant;

†Prolonged paralytic ileus was seen only in patients who underwent open surgery;

††Chronic surgical site pain was seen only in patients who underwent laparoscopic surgery.

temic diseases, such as anemia, DM, *etc.* [7,8]. As for the younger and healthy female patients with Pfannenstiel incisional hernia, very few studies in the literature report that smoking and obesity, as modifiable factors related to lifestyle, are independently associated with increased risk [9,22]. It is well known that cigarette smoking negatively impacts wound healing process, and local wound complications such as seroma are more common in operated patients with higher BMI [23]. Moreover, maternal overweight and obesity have been rising very rapidly for the last three decades, reaching over 50% in many developed or developing countries [24]. In our series, the ratio of patients with BMI >25 was about 60% and smoking was identified as a significant risk factor for over one third of patients. It is clear that excess adipose tissue in waist area can make the incision site prone to fat necrosis and seroma. Furthermore, the dissection made to separate bowels from the abdominal fascia and to prepare a space for onlay mesh fixation may result in bleeding or hematoma. Besides, mesh itself as a foreign material, may increase the risk of infection or abscess formation [25].

Shand *et al.* [26] have suggested that women with two CSs had a threefold increased risk of incisional hernia, which increased to sixfold after five CSs (95% confidence interval (95% CI) 3.99–9.93, $p < 0.001$) compared to

women with no CS. Additionally, in a recent study of Larson *et al.* [27], it has been shown that more than one section, obesity and smoking significantly increased the risk for complications after CS. Similarly, in our study, risk of having a hernia was higher among women who have multiple CSs ($p < 0.01$). Moreover, not only the pregnancy induced risks such as diabetes and emergency CS but also incision site complications such as seroma, hematoma, infection or inadequate surgical technique were found as important risk factors for Pfannenstiel incisional hernia (each, $p < 0.05$).

Radiologic workup including US, CT or MR imaging has always been used for definitive diagnosis of hernia [28–30]. However, since majority of our patients had significant bulging at their suprapubic area, radiology often provided us with a road map offering guidance in operative planning and also raised awareness of possible pitfalls that could occur during surgery. We usually combined soft tissue US (90%) with at least one of the contrasted pelvic CT (70%) or MR (30%) scan. Therefore, in our series, there was no important morbidity such as bowel injury requiring suture raphy or diverting stoma. Moreover, knowing the anatomic structures and adhesions between the fascia and bowel loops or pre-placed mesh in complicated cases helped us decide on the type of dissection or surgery. Al-

though there are many publications reporting clear advantages of minimal invasive incisional herniorrhaphy since its introduction in early 1990s, most recent studies from high volume hospitals suggest similar outcomes in open and laparoscopic surgery [31–33]. In our series, prolonged paralytic ileus was seen only in patients who underwent open surgery ($p < 0.05$), since all difficult cases have been operated in this way. On the other hand, chronic surgical site pain was seen only in patients who underwent laparoscopic surgery ($p < 0.05$). This finding is suitable with the literature reporting tacker induced neuralgia or chronic pelvic pain in patients with minimally invasive hernia repair. However, other outcome parameters were similar in both techniques. Seroma and infection were the most frequent early postoperative complications ($p < 0.01$ and $p < 0.05$, respectively), and they were listed as risk factors for incisional hernia, as well. Recurrence rate in our patients who underwent open or laparoscopic Pfannenstiel incisional herniorrhaphy with mesh reinforcement was 7% on an average of 6 years of follow-up period.

The present study has several strengths. It has a comparably large sample size and provides information on treatment practices in such a specific population. This enhances external validity, i.e., the generalisability of the method. On the other hand, main limitations of the study are its retrospective design and observational nature leaving the possibility of confounding bias.

5. Conclusions

In conclusion, since worldwide CS rate continues to rise, clinicians will encounter reproductive-aged women with incisional hernia much more often. Identification of risk factors, assessment of abdomen with proper radiological imaging, and awareness of surgical options are of great importance for a good outcome.

Availability of Data and Materials

All raw data (on Excel format with all patients' names shaded) and statistical work about this study are available upon request as supplementary files (please contact the corresponding author).

Author Contributions

AF: conception, formal analysis, investigation, methodology, writing original draft in English, re-writing after review and final edition. NS: operations on patients, obtaining Ethics Committee approval, data curation, interpretation of data, review, revising the draft critically for important intellectual content. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work. Both authors read and approved the final version of manuscript.

Ethics Approval and Consent to Participate

Approval for the present study was obtained from the institutional review board of University of Medipol, Medical Faculty (01.08.2023/E-10840098-772.02-4702). All patients provided informed consent.

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Conflict of Interest

The authors declare no conflict of interest.

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