Prevention of Incisional Hernia in Ovarian Cancer Patients Undergoing Midline Laparotomy

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Abstract

BACKGROUND: Incisional hernias (IH) are a frequent complication of midline laparotomies in abdominal surgery. This study was conducted in order to determine the efficacy of mesh placement and assess the optimal fascia closure technique to reduce the IH rate in patients surgically treated after being diagnosed with malignant or borderline ovarian tumors.

METHODS: Retrospective data from patients undergoing midline laparotomy for borderline or ovarian cancer in Hospital del Mar, Barcelona, from January 2008 to December 2019 were collected. Patient demographic, preoperative and intraoperative characteristics and risk factors for hernia were reported. The incidence of IH between groups (mesh and non-mesh) and the technique used in fascial closure for each patient (small bites technique vs large tissue bites) was reported.

RESULTS: In total, 133 patients with available data for follow-up were included. After clinical and radiological examination, 25 (18.79%) of them showed IH.

18 of 61(29.5%) patients in non-mesh group developed IH, compared with 7 of 72 (9.7%) in mesh group (OR 0.25, 95% CI 0.09-0.66, $p<0.005$). Patients of large tissue bites group showed higher prevalence of IH compared with small bites technique group without statistical significance (OR 0.46, 95% CI 0.17-1.24, $p=0.119$). The combination of mesh reinforcement and small bites technique for fascial closure significantly reduce IH risk ($p=0.021$).

CONCLUSION: Incidence of IH is high in patients undergoing midline laparotomy for ovarian cancer or borderline ovarian tumor. The addition of a prophylactic mesh and use of small bites technique may reduce the incidence of IH and potentially minimize the social impact and costs of this complication.

1. Introduction:

Ovarian cancer is one of the leading causes of cancer-associated female mortality and continues to be a challenge in gynecologic oncology[1]. Nowadays, optimal cytoreductive surgery is key to improve prognosis[1]. Despite the increasing use of minimally invasive surgery in gynecologic cancer, standard access for management of ovarian cancer is laparotomy, through a midline abdominal incision[2].

Incisional hernia (IH) arises up to 10–40% of laparotomic abdominal surgeries[3]. IH may cause pain, cosmetic problems and impaired quality of life. It can also be related to life-threatening complications such as incarceration or strangulation of the content of the hernia. Even more, IH not only is a medical condition but it also has a great socio-economic impact, that makes prevention of vital importance [4,5,6,7].

Risk factors for IH have been related to patient characteristics (e.g., older age, obesity, diabetes, immunosuppression, malignant disease, previous surgeries), hernia characteristics (e.g., location, mesh) and surgical performance (length of surgery, expertise)[8]. In order to prevent IH, various approaches have been described, such as suture techniques and use of prophylactic meshes. In the past decade,

satisfactory results associated to prophylactic mesh have been published in some subgroups of patients at risk of developing IH such as vascular surgery for aneurism, bariatric surgery and presence of other individual risk factors [9,10,11].

Currently, there is a lack of studies concerning IH in surgically treated gynecologic population. We therefore conducted a study in order to determine the efficacy of mesh placement and to assess the optimal fascia suture technique to reduce the IH rate after midline laparotomy in patients with ovarian cancer or borderline ovarian tumors.

2. Methods:

A retrospective study including all consecutive patients with a diagnosis of ovarian cancer or borderline ovarian tumor who underwent midline laparotomy was conducted in the Department of Obstetrics and Gynecology at Hospital del Mar, Barcelona, from January 2008 to December 2019. Patients included in the study should have been followed up at least one year after surgery.

Follow-up involved regular medical visits and imaging, according to the latest Oncology Guidelines[12].

The exclusion criteria were as follows: laparoscopic approach, incision outside the midline, immediate postoperative period death and history of previous incisional hernia (IH).

To determine the efficacy of mesh placement in prevention of IH and to assess the optimal fascia suture technique, incidence of IH was reported depending on type of suture and/or mesh placement. A comparison was made between groups.

All risk factors related to abdominal wall complications were recorded: age, body mass index (BMI), alcohol intake, smoking habit, diabetes mellitus, cardiac risk factors, hypertension, steroid use, previous operations, preoperative serum haemoglobin level, preoperative serum albumin, creatinine level, American Society of Anaesthesiologists (ASA) score and suboptimal cytoreduction. Operative time and total hospital stay were also analysed.

Before 2015, the decision of mesh placement and suture technique was at the surgeon’s discretion, according to clinical estimation of IH risk. After this date, our hospital established a new protocol in accordance with the European Hernia Society guidelines on the closure of abdominal wall incisions, placing a prophylactic mesh in patients at risk of developing IH[13,14].

For the primary suture procedure, the midline fascia was closed according to the principles of small bites technique or conventional large tissue bites described elsewhere previously and following the standard of care present at the time of surgery.[4] The small bites technique consists in applying tissue bites of 5mm using a running, slowly absorbable suture (Polidyoxanone 2/0 USP, HR 26 Monoplus®, B. Braun. Melsungen. Germany) with a suture length-to-wound length ratio of 4:1. The conventional large tissue

bites was applied with tissue bites of at least 1cm using a monofilament construction (Polydyoxanone 1 USP looped, needle HRT 48, PDSII ®Ethicon, Somerville, NJ, USA)[4].

For suprafascial (onlay) mesh placement, an anterior plane was created between the anterior rectus fascia and the subcutaneous and a Polyvinylidene fluoride mesh (DynaMesh®-CICAT, Aachen, Germany) was used and sutured with a double crown of absorbable monofilament suture (PDS II, Ethicon, Somerville, NJ, USA). In all patients of this group, subcutaneous closed suction drains were placed.

IH was defined as any abdominal wall gap in the area of a postoperative scar palpable or perceptible by specialists or detected on radiologic follow-up, as determined by European Hernia Society (EHS)[13].

Statistical analysis was performed using the Statistical Package for Social Sciences v. *18.0* (SPSS, Chicago, IL). Quantitative variables were expressed as mean and standard deviation (SD), and categorical variables as absolute numbers and percentages. The association between qualitative variables was assessed using contingency tables with Chi-square test and Fisher test, when necessary, and the analysis of the quantitative variables was performed with the Student t-test parametric test or the nonparametric Mann-Whitney U test when needed. Statistical significance was set at $p<0.05$. The odds ratio (OR) of hernia incidence was calculated with its confidence intervals (CI). Survival curves for IH incidence were estimated by a Kaplan-Meier method and risk was assessed using a log-rank test.

The study was approved by the Ethics Committee of the Hospital del Mar number 2020/9228 and was carried out in compliance with the guidelines of the Declaration of Helsinki, Fortaleza, Brazil, 2013. A waiver of informed consent was obtained from the Institutional Ethical Review Board from the home Institution.

3. Results:

Of a total of 196 patients diagnosed of ovarian cancer or borderline ovarian tumor in our unit during study period, 133 patients were included in the study and accomplished inclusion criteria. Of them, 61 patients were included in non-mesh group (46 in non-mesh large bites group, and 15 in non-mesh small bites group) and 72 in mesh group (37 in mesh large bites group, and 35 in mesh small bites group).

See Figure 1: Consort diagram of the study. Legend: This figure illustrates the study design. A total of 133 patients will be included in the study: 61 in non-mesh group and 72 in mesh group.

The mean follow-up time was 54.74 months ± 34.80 (SD) in mesh group and 60.56 ± 36.70 in non-mesh group.

Demographic, baseline disease characteristics and surgical closures technique are shown in Table 1.

TABLE 1. Demographic, preoperative, and intraoperative characteristics of Patients by Groups

	Total population	**Mesh**	**Non-mesh**	***P***
	(n=133)	**(n= 72)**	**(n= 61)**	
	mean±SD	mean±SD	mean±SD	
	n (%)	n (%)	n (%)	
Age (years),	59.83±14.34	63.38 ± 13.2	55.66 ± 14.6	0.002
BMI (Kg/m^2)	26.79± 4.87	27.59 ± 5.45	25.86 ± 3.95	0.041
Disease Stage				0.004
I-II	38 (28.6)	13 (18.05)	25 (41)	
III-IV	95 (71.4)	59 (81.9)	36 (59)	
Cell Histology				0.084
Serous	85 (63.9)	54 (75)	31 (50.8)	
Mucinous	12 (9)	3 (4.2)	9 (14.8)	
Endometrioid	18 (13.5)	8 (11.1)	10 (16.4)	
Clear Cell	6 (4.5)	2 (2.8)	4 (6.6)	
Adenocarcinoma and Carcinoma NOS	3 (2.3)	1 (1.4)	2 (3.3)	
Others	9 (6.8)	4 (5.6)	5 (8.2)	
Pathology Grade				0.011
Low	38 (28.6)	14 (19.4)	24 (39.3)	
High	95 (71.4)	58 (80.6)	37 (60.7)	
Cytoreductive Surgery				0.222
Optimal	125 (94)	66 (91.7)	59 (96.7)	
Suboptimal	8 (6)	6 (8.3)	2 (3.3)	
Diabetes mellitus	12 (9)	8 (11.1)	4 (6.6)	0.361
Alcohol	7 (5.3)	2 (2.8)	5 (8.2)	0.163
Smoking habit	30 (22.6)	9 (12.5)	21(34.4)	0.003
Cardiac Risk Factors	18 (13.5)	11 (15.2)	7 (11.5)	0.523
Hypertension	48 (36.1)	29 (40.3)	19 (31.1)	0.275

Steroid Use	1 (0.8)	0 (0%)	1 (1.6)	0.275
Previous Abdominal Surgeries	114 (85.7)	65 (90.3)	49 (80.3)	0.102
Laparoscopy	67 (50.4)	38(52.3)	29(47.5)	
Midline laparotomy	14 (10.5)	6 (8.3)	8(13.1)	
Pfannenstiel's incision	19 (14.3)	12(16.7)	7(11.5)	
McBurney's incision	11 (8.3)	7 (9.7)	4 (6.5)	
Kocher incision	3 (2.3)	2 (2.8)	1 (1.6)	
ASA Class				0.216
1	10 (7.5%)	4 (40%)	6 (60%)	
2	79 (59.4)	40 (50.6%)	39 (49.4%)	
3	43 (32.2%)	28 (65.1%)	15 (34.9%)	
≥4	1 (0.8%)	0 (0%)	1 (100%)	
Preoperative Serum Albumin	4.16± 0.51	4.19 ± 0.43	4.12 ± 0.60	0.427
Preoperative Hemoglobin	11.76± 1.62	11.65 ± 1.61	11.87 ± 1.64	0.447
Preoperative Serum Creatinine Level	0.78± 0.29	0.76± 0.29	0.81 ± 0.3	0.355
Operative Time (min)	265.61 ± 106.49	284.44 ±107.62	243.58± 101.57	0.026
Total Hospital Stay (days)	10.56± 14.68	11.54 ± 17.44	9.39± 10.58	0.403

BMI= body-mass index.

NOS=Not otherwise specified.

ASA= American Society of Anesthesiologists.

PRBCs= Packed Red Blood Cells.

The non-mesh group contained a significantly greater proportion of younger (55.66 vs 63.38 years; p=0.002), smokers (34.4 vs 12.5; p=0.003) with lower BMI (25.86 vs 27.59Kg/m^2; p=0.041) patients and ultimately presenting with less advanced disease (37.9% vs 62.1%; p=0.004). However, patient's comorbidities and laboratory parameters were similar between groups.

Operative time was 41 minutes longer into mesh group patients (284.44 vs 243.58 minutes; p=0.026) whereas length of hospital stay was similar in both groups.

After data-analysis, 25 of 133 patients showed IH detected either by clinical and/or radiological examination, with an overall incidence of 18.79%. 18 of 61(29.5%) patients in non-mesh group developed IH, compared with 7 of 72 (9.7%) in mesh group (OR 0.25, 95% CI 0.09-0.66, p<0.005). See Table 2.

TABLE 2. IH Rate	**IH=25**	**No IH=108**	***P***
			0.005
Mesh	7(9.7%)	65(90.3%)	
Non-mesh	18(29.5%)	43(70.5%)	
ODDS RATIO	0.25 (95%CI, 0.09-0.66)		
			0.119
Large Bites Technique	19(22.9%)	64(77.1)	
Small Bites Technique	6(12%)	44(88%)	
ODDS RATIO	0.46 (95%CI,0.17-1.24)		
IH = Incisional Hernia			

Kaplan-Meier curves for IH are shown in Figure 2: Cumulative risk of incisional hernia. Legend: This figure illustrates the cumulative risk of incisional hernia (in months) after midline laparotomy for ovarian tumours, presented for all patients: with mesh and without mesh.

In mesh group, mean IH time of diagnosis was of 17.63 months ± 4.9 (SD) whereas in non-mesh group 16.90 ± 20.9 (SD).

The comparison curves of cumulative risk of IH using log-rank test showed a statistically significant difference between groups (p=0.017).

In reference to midline fascia closure technique, 19 of 83 (22.9%) patients in the large tissue bites group presented IH compared to 6 of 50 (12%) patients in the small bites group (OR 0.46, 95% CI 0.17-1.24, p=0.119). See table 2.

Figure 3 shows IH incidence when combining both techniques: Incidence of incisional Hernia. Legend: The incidence of IH in patients with small bites technique for primary suture and mesh reinforcement was 8.6% compared to 10.8% in patients with large bites technique and mesh reinforcement, 20% in patients with small bites technique and no mesh reinforcement and 32.6% in patients with large bites technique for fascial closure and no mesh reinforcement (p=0.021).

11 patients of 25 (44%) had symptoms because of the IH. Of those, 8 (72.7%) were in the non-mesh group and 3 (27.3%) in the mesh group.

Of all 25 IH, a total of 13 required surgery (52%). In the group of surgical IH, 10 patients did not have a prophylactic mesh (77%).

4. Discussion:

4.1 Summary of Main Results

The present study shows that use of onlay prophylactic mesh, reduces the incidence of IH after midline laparotomy for ovarian tumours.

Incisional hernia is an important complication after a midline laparotomy with a huge social and financial impact, which makes prevention fundamental.[5] Even though there are still numerous surgeries in gynaecology that are performed using a midline incision, the incidence of IH is not as studied as in other fields. Franchi et al, in 2001, in a 10-year study, reported an incidence of IH of 16.9% after abdominal hysterectomy[15]. Most studies on the incidence of IH in elective surgery have reported ranges between 11-20%[16]. In our study, the incidence of IH after median laparotomy for borderline or ovarian cancer was 18.8%, showing similar rates as published in literature.

Risk factors for IH after abdominal surgery have been well described. The protrusion of intraperitoneal structures seems to occur when multiple predisposing factors are present (diabetes, immunosuppression, obesity, old age, malignant disease, malnutrition, technical factors)[17,18,19,20].

Acording to our department protocol on abdominal wall closure, age >60, obesity and immunosuppression are risk factors to consider the use of a prophylactic mesh. As it was expected, risk factors for IH were well balanced between groups of our study, except for age, BMI, smoking habit, disease stage and pathology grade, all of them non-modifiable risk factors at time of surgery. Accordingly, operative time was 41 minutes longer into mesh-group patients, which is approximately the time needed for a surgeon to close the midline fascia and place the mesh.

4.2 Results in the Context of Published Literature

Abdominal wall closure techniques continue to evolve in an attempt to achieve the best outcome for patients undergoing midline incisions. There are several trials showing effectiveness of prophylactic mesh placement[9–11]. In our study, a synthetic large pore mesh manufactured from Polyvinylidene monofilament fibers (DynaMesh®-CICAT) was chosen. The anatomical and biomechanical properties of these type of mesh are practically identical to those of the human abdominal wall and offers a rigidity and elasticity that contributes to a physiologically normal dynamic of the abdominal wall[21]. The suprafascial position was chosen because the surgical technique is much simpler and quicker, and good results with this position have been published[7,22]. Moreover, it is a feasible procedure after peritoneal peritonectomy in some cases of ovarian cancer surgery.

Existing data from a systematic review, suggest that prophylactic mesh placement is associated with an 85% postoperative incisional risk reduction when compared to primary closure in at-risk patients undergoing elective, midline, laparotomy closure[6]. Specifically, data from studies such as those from Garcia-Ureña et al, conclude that prophylactic large-pore polypropylene mesh on the onlay position decreases the incidence of IH in patients undergoing elective or emergency surgery for colorectal disease; 17 of 54 IH were identified in non-mesh group (31.5%) compared with 6 of 53 IH (11.3%) in mesh group (p=0.01)[5].

In our study, 18.79% (25/133) of IH were reported, of them 29.5% (18/25) in the non-mesh group and 9.7% (7/25) in the prophylactic mesh group (p=0.004), supporting the idea that mesh placement appears to significantly reduce the risk of IH after midline laparotomy in ovarian cancer patients, which is in concordance to the previous studies. Remarkably, the majority of patients that had symptoms because of the IH were in non-mesh group (8 out of 11 patients) and also the majority of IH that required surgical repair were in non-mesh group (10 out of 13 patients), supporting the idea that if a IH develops in a patient with a mesh, it is smaller and probably related with less complications[23].

In an effort to prevent IH after midline laparotomies, there is also growing interest in the role of primary fascial closure after midline laparotomy. A randomized controlled trial by Deerenberg et al, reported that 21% of patients in the large bites group and 13% of patients in the small bites group had IH (p=0.022)[4]. These results shows that small bites suture technique is more effective than traditional large bites technique for prevention of IH in midline incisions. In front of these data, the EHS-guidelines on the closure of abdominal wall incisions suggest that a small bites technique is the current recommended method of fascial closure[13]. Although it did not reach statistical significance (p=0.119), the analysis of our data, found that only 6 patients developed IH (12%) when fascia was closed with a small bites technique while 19(22.9%) developed IH when a conventional suture closure was used.

In an attempt to combine techniques that could result in an additional reduction of the IH rate, this study showed that the best available technique seems to be the combination of small stitched and onlay mesh, resulting in a reduction of IH of 8.6% versus 32.6% in patients with large bites technique and no mesh reinforcement (p=0.021).

4.3 Strengths and Weaknesses

One of the strengths of the study is that it is the first to attempt to answer the question whether or not a prophylactic mesh can reduce the incidence of IH in ovarian tumour patients undergoing midline laparotomy and to assess the optimal fascial closure technique. Moreover, it takes into account the combination of the two techniques searching an additional decrease of the IH rate. At present, there is a lack of studies among gynaecologic population and the evidence to recommend mesh placement in patients with ovarian cancer or borderline ovarian tumors undergoing midline laparotomy is poor. Another strength is the fact that our hospital follows a protocol in accordance to the EHS- guidelines on the closure of abdominal wall incisions, ensuring a high degree of uniformity regarding the surgical technique of wall closure.

However, this study has some limitations. Firstly, it is a retrospective study placed in a single institution, with both selection and interpretation bias. Secondly, our primary analysis was done in some patients with 1 year of follow-up and previous studies have shown that the length of follow-up seems to affect the incidence of IH[24].

4.4 Implications for Practice and Future Research

Prevention of IH is of paramount importance. We believe our findings are clinically significant, reducing the incidence of IH and therefore minimizing not only the large effect in medicine but also the great socioeconomic impact of this complication.

Future studies should be focused on answering some important questions as post-operative complications between groups and possible impact of mesh placement on oncologic outcome. There are also a variety of mesh types and locations that this study has not assessed, and could be taken into account for future research.

5. Conclusion:

In summary the incidence of IH is a frequent complication in patients undergoing midline laparotomy for ovarian cancer or borderline ovarian tumour. In accordance to the recommendations of EHS-guidelines[13], the addition of a prophylactic mesh on the onlay position and the use of the small bites technique for midline fascia closure, may reduce the incidence of IH after midline laparotomies for borderline or ovarian cancer.

Abbreviations

IH
Incisional Hernia
OR
Odds Ratio
BMI
Body Mass Index
ASA
American Society of Anaesthesiologists
EHS
European Hernia Society
SPSS
Statistical Package for Social Sciences
SD
Standard deviation
CI
Confidence intervals

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Hospital del Mar number 2020/9228 and was carried out in compliance with the guidelines of the Declaration of Helsinki, Fortaleza, Brazil, 2013. A waiver of informed consent was obtained from the Institutional Ethical Review Board from the home Institution.

Consent for publication: not applicable

Availability of data and materials: The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author (Mancebo Moreno, Gemma) on reasonable request.

Competing interests: The authors declare that they have no competing interests

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Authors' contributions

-Study concepts: BF, EM, JSS, JP, GM

-Study design: BF, EM, JSS, JP, GM

-Data acquisition: BF, EM

-Quality control of data and algorithms: BF, EM, JSS, JP, GM

-Data analysis and interpretation: BF, EM, GM

-Statistical analysis: EM

-Manuscript preparation: BF, EM, JSS, JP, GM

-Manuscript editing: BF, EM

-Manuscript review: BF, EM, JSS, JP, GM

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Figures

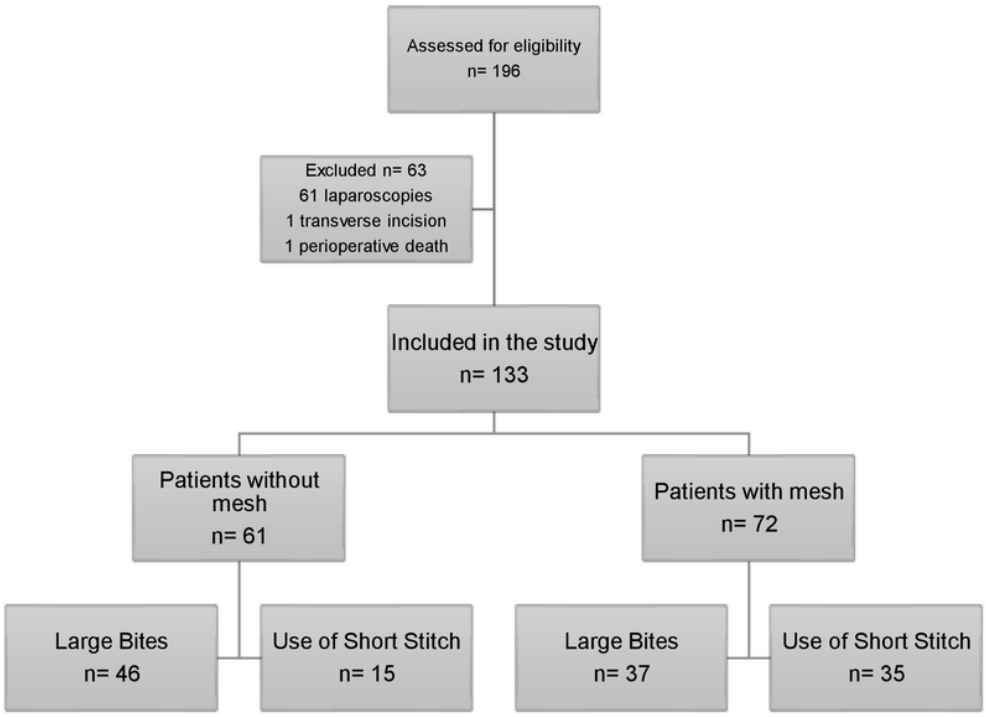

FIGURE 1. CONSORT diagram of the study.

Figure 1

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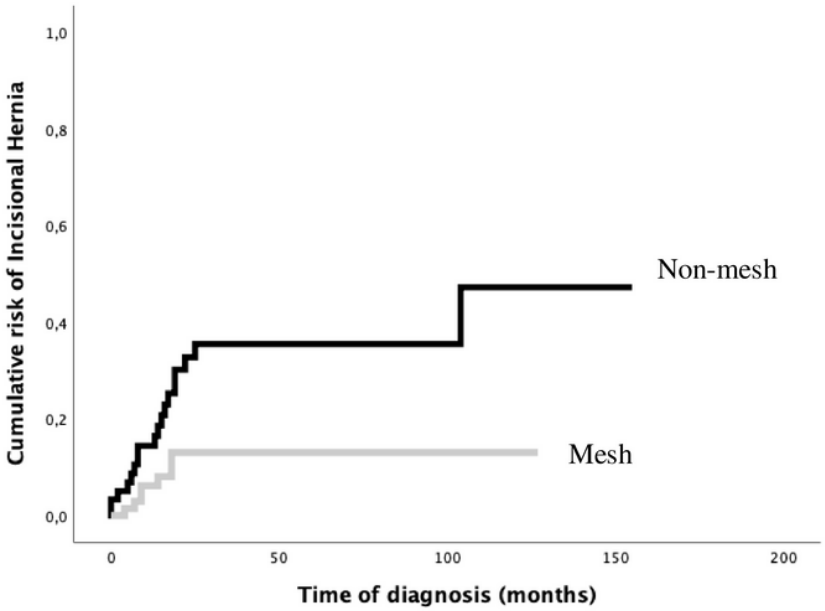

FIGURE 2. Cumulative risk of incisional hernia

Figure 2

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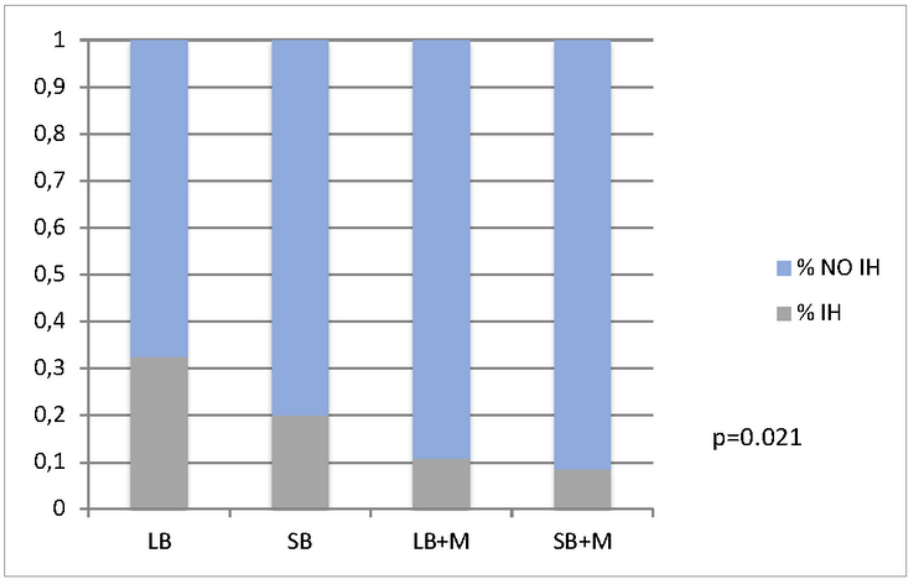

LB = Large Bites Technique
SB = Small Bites Technique
LB+M = Large Bites Technique + Mesh reinforcement
SB + M= Small Bites Technique + Mesh reinforcement

Figure 3

Incidence of incisional hernia (IH)