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Original

PREDICTIVE FACTORS FOR INCISIONAL HERNIA AT THE EXTRACTION SITE AFTER
LAPAROSCOPIC RIGHT COLECTOMY FOR CANCER: A LARGE 8-YEAR
OBSERVATIONAL STUDY

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ABSTRACT (max 150 words)

BACKGROUND: Incisional hernia at the extraction site (ESIH) is a common complication after laparoscopic colorectal resection. The aim of this study was to evaluate the prevalence and the risk factors for ESIH in a large cohort study.

METHODS: A cross-sectional study was performed including all patients who underwent elective laparoscopic right or extended right colectomy for cancer from November 2006 to October 2013. All of patients have been followed up with a minimum of one year with CT scan.

RESULTS: A total of 292 patients were included with a median follow-up of 42 months. Twenty patients (6.8%) developed ESIH. Obesity (OR= 3.76, 95%CI 1.39-10.15; p=0.009) and an incision length (OR: 2.86, 95%CI: 1.077-7.60; p=0.035) were significant predicting variables of developing ESIH.

CONCLUSION: This study identified several factors that were significant as predictive factors of ESIH after laparoscopic right colectomy.

INTRODUCTION

Laparoscopic approach has been established as the standard treatment for colonic cancer. Its benefits in terms of short outcomes and long term oncological follow-up are well known.^{1,2} The technique in the resection of right sided cancer include laparoscopic right colectomy or extended right colectomy according to the site of the tumor.^{3,4} Despite its standardized technical principles, there are some variations performed by different surgeons, including the location of port sites, the fashioning of extraction site incision to retrieve the specimen and of the anastomotic technique.

Incisional hernia at the extraction site (ESIH) is one of the most common complications after laparoscopic colorectal resection.⁵ The appearance of this complication ranges between 5 and 20% in the scarce published series.^{6,7}

Information about the risk factors for ESIH could be useful in order to introduce preventive measures. Some series were published aiming to study the real prevalence of this complication and to analyze which patients are at risk.^{8,9} However most of them are mixing different types of surgical procedures, there is a lack of a minimum follow-up and therefore no conclusions have been achieved.

The aim of this study was to analyse the prevalence of ESIH in a cohort of a homogeneous sample of patients who have undertaken a laparoscopic resection for a right-sided colon cancer. Also, risk factors for development of this complication with a minimum follow-up of one year have been extensively investigated.

METHODS

A retrospective analysis was undertaken of patients data collected prospectively in our colorectal surgery database from November 2006 to October 2013. This is a cross-sectional designed study of all details of patients who underwent elective laparoscopic right or extended right colectomy for cancer in the study period.

Inclusion and exclusion criteria

All consecutive patients with colon cancer in the right colon (cecum, ascending colon, hepatic flexure and transverse colon) who underwent a laparoscopic right colectomy or a laparoscopic extended right colectomy during an 8-year study period were included on the analysis. Exclusion criteria were: conversion to laparotomy, surgical reintervention through a laparotomy, vaginal extraction of specimen or patients with a follow-up less than one year and/or without CT scan. Also, no single incision surgical procedure was included in the study. All included patients had a minimum one-year follow-up. In all of them CT scan was done and reported by the same 5 specialists.

Surgical technique of lap procedure and closure of extraction site incision

All cancer resections were performed by experienced laparoscopic surgeons or by higher surgical trainees under direct consultant supervision. Laparoscopic mesocolic excision was performed in all cases adhering to the oncological principles of cancer resection. No bowel preparation was used for right-sided resections. Port placement for right colonic resections included the use of 4 trocars (two 12 mm and two 5 mm). PCA or local blocks were the preferred option for pain relief, however epidural anesthesia was also used in some cases. Enhanced recovery was the standard of care for all these cases. Primary vascular ligation was followed by medial to lateral dissection and then division of colon with clear margins. A stapled or hand sewn anastomosis was fashioned based on

operator's preference. The type of incision to retrieve the specimen was decided based on surgeon preference. For its closure a standard technique was done in all cases, including a running suture of PDS in one or two layers, for midline incision or other sites respectively. The skin was closed with a subcuticular suture with an absorbable material.

Study variables

The endpoint was to analyse the prevalence of incisional hernia at the extraction site, in a diagnosis performed with a CT scan (Figure1), with a minimum follow up of 1 year in the overall series. Also we aimed to study the characteristics of patients who developed this complication.

The following variables were analysed: Age, gender, BMI, operative data (including technique and operative time), clinical data including postoperative complications, variables regarding the length and site of extraction incision. Also the data on the pathological analysis of the specimen were included in the study. For the staging of the colonic tumor we used the 7th edition of the TNM staging system.

Statistical analysis

All results and variables were introduced in a specially designed database. Continuous variables are presented as mean $\pm$ standard deviation, and ranges and categorical variables as absolute numbers or percentages. Chi-square tests were used to compare differences in categorical variables (Fisher's exact tests were used as needed), and Student's t tests were used for continuous variables. Univariate analysis and multivariate logistic regression analysis were performed to identify independent predictive causal factors for the development of ESIH. Adjusted odds ratios (ORs) were calculated using logistic regression. Variables achieving statistical significance in the univariate analysis

were considered for multivariable analysis. ORs with 95% confidence intervals (CIs) are presented for each studied variable. Differences were considered to be significant at the 5% level. All p values reported were two sided. Statistical analyses were performed using SPSS version 20.0 (SPSS™, Inc, Chicago, IL, USA).

RESULTS

From November 2006 to August 2014, we performed 352 laparoscopic right or extended right colectomy. In the Figure 2 there is the flow chart of all patients included in the series. After several exclusions, the data of 292 patients were analysed in the final analysis.

There were 127 males (43.5%) and 165 females (56.5%), with a mean age of 73.3 ± 10.46 years, a mean BMI of 26.2 ± 4.74 Kg/m². In overall series studied 35.9% of patients has previous abdominal surgery and 32.8% of them a high anesthetic risk measured as an ASA score more than III.

During a median follow-up of 42 months (range 12-96), 20 patients (6.8%) developed ESIH. In the Table 1 there is the characteristics of patients who had this complication compared with the patients without incisional hernia. There were no significant differences between groups in the characteristics of tumor, surgical technique or postoperative data. The rate of ESIH was higher in the patients with umbilical midline incision (9.1%) than other sites (3.4%). However this difference was not statistically significant ($p=0.062$) (Table 1).

In the table 2 there are the results of the predictive study to know which variables were a risk factors for ESIH. In the multivariable analysis a BMI > 30 (odds ratio [OR]= 3.76, 95% confidence interval CI 1.39-10.15; $p=0.009$) and an incision length more than 5 cm (OR: 2.86, 95% CI: 1.077-7.60; $p=0.035$) were significant predicting variables contributing to the risk of developing ESIH (Table 2).

Of the 20 patients with ESIH, 6 of them were operated and no recurrence of the hernia in the follow up and the remaining they are awaiting the procedure.

DISCUSSION

In our experience, around 7% of patients will develop an incisional hernia after laparoscopic resection for right sided cancer. This study identified several factors that could be useful to introduce preventive measures in high-risk patients such as mesh closure, reducing the length of incision by intracorporeal anastomosis and non-umbilical extraction site in high-risk patients. There is no data regarding which site of incision could be better to diminish these complications in these patients.

The present study has some strength. It is the largest homogenous series of patients who had a laparoscopic procedure for a right-sided colon cancer. However, our study also has some limitations. Mainly the main limitation is that despite that the data was collected prospectively, this is a retrospective analysis.

Incisional hernia at the extraction site (ESIH) is recognized of one of the most common complications after laparoscopic colorectal resection.⁵ The appearance of this complication has a range of incidence accounting for a 20% of patients in some series.^{7,10} A part from our series, the largest published experience included 1057 cases.¹¹ However, it is a retrospective series, including open and laparoscopic procedures. In their results from 289 laparoscopic resections followed up, 15.9% developed incisional hernia including port site in the overall results, and specifically 5.1% on the midline incision for the laparoscopic right colectomies.

There is some controversy regarding the best method to follow-up the patients in order to have a diagnosis of ESIH. In a previous previous study was stated that the use of CT scan for the follow-up increase the percentage of diagnosis of incisional hernia in these

patients. *Claes et al*⁷ demonstrated on a series of 76 patients a percentage of ESIH of 6.2% with this management. This is why we decided to use this method in our series rather than only clinical assessment with physical exam.

As far as we know this is the first study, analysing the predictive factors of this complication in a homogenous series of right laparoscopic procedure. *Sadava et al*.⁸ in a mixed series of patients operated for cancer and benign diseases, they found as a significant variables for the development of ESIH, the BMI and surgical site infection. In study including patients with single incision technique (SILS), only the use of this new technique was a predictive factor of this clinical problem on the follow-up.⁹ Interestingly in a recent elegant study, in a series of 193 patients operated for colorectal cancer with a mixed techniques, rather the BMI, visceral obesity measured by CT scan was significant as a predictive factors for a development of incisional hernia.¹⁰ Probably more results are needed to address the real value of this results.

There is a scarce data on how to prevent this complication. One of the most controversial issues is to know if there is any benefit on to use a midline incision vs. other sites. *Lim et al*.¹² in a study were 147 left sided laparoscopic procedures were included (sigmoid and rectal cancer resections), they did not found any clinical differences in between the clinical complications between these two type of sites of the incision (transumbilical incision 2/92 vs. left transverse incision 0/55, $p=0.810$). Nevertheless in our experience, we did not found this variable clinical relevant in right sided surgical procedures. *Williams et al*¹³ demonstrated in a prospective series of 15 patients, the benefit of using a transverse right incision and preservation of rectus abdominis muscle. There is no a randomized control trial but in their experience none of the patients in a 24 month follow up developed any incisional hernia.

Nowadays there is a controversy regarding the rate of abdominal wall complications comparing single incision technique vs. standard laparoscopic approach as a new evolving technique.¹⁴ In a retrospective comparative analysis of all colorectal techniques (including also total colectomy or creation of stoma), there was a significant higher percentage of incisional hernia in the group of patients with single incision technique (17% vs. 7.6%, $p=0.03$).⁹ Also, the use of intracorporeal anastomosis in laparoscopic right colectomy has been suggested to diminish the size of the extraction site incision and therefore this could be related to less abdominal wall complications in a non-controlled trials.¹⁵⁻¹⁷ Finally, the value of prophylactic mesh to avoid incisional hernia in patients at risk has been suggested.¹⁸ The scientific evidence is scarce, but recently a RCT was published its benefits in colorectal surgery when an open procedure is needed.¹⁹ As far as we know, there is a limited experience in laparoscopic surgery, and only in the prevention of port site incisional hernias in laparoscopic cholecystectomy.²⁰ Therefore a RCT in patients at risk of incisional hernia who need laparoscopic colorectal resection are warranted.

In conclusion, in our experience during a median follow-up of 42 months, 6.8% of patients developed ESIH after laparoscopic resection of right-sided colon cancer. This study also identified several factors that were significant as predictive factors of ESIH after laparoscopic right colectomy that could be useful for the introduction of preventive measures.

FIGURE AND TABLE LEGENDS

Figure 1. Flow chart of patients included in the study.

Figure 2. Imaging of CT scan showing an incisional hernia at the extraction site after laparoscopic right colectomy.

Table 1. Characteristics of patients according to development of incisional hernia after a minimum follow-up of 1 year.

Table 2. Results of univariate and multivariate analysis of the study of predictive factors for Incisional hernia in overall series.

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