



## RISK FACTOR ANALYSIS OF TYPE COLORECTAL OPERATION AND INTRA-ABDOMEN CONTAMINATION ON EVENT POST OPERATIVE ADHESION: SYSTEMATIC REVIEW AND METAANALYSIS

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### ABSTRACT

**BACKGROUND:** Colorectal surgery is the highest incidence of adhesion-related problems. The type of surgery might be total colectomy, right hemicolectomy, left hemicolectomy, segmental colectomy, Hartmann procedure, and colostomy. Surgical procedures performed on the colon could be contaminated. The most common contamination is faecal contamination. Various causes of peritoneal irritation result in localized fibrin production, which results in adhesion to the surfaces in contact.

**PURPOSE:** This study focused on the type of colorectal surgery and intra-abdominal contamination on the incidence of postoperative adhesions.

**METHOD:** Systematic review and meta-analysis. We searched for published journal on types of colorectal surgery and contamination with adhesion events published from 2010-2020 using electronic database : Pubmed, Science Direct and Cochrane.

**RESULT:** Ten journals (8 cohort and 2 case control) were included in the meta-analysis. In the risk factors for colorectal surgery: APR surgery, total colectomy and rectal resection had a significant risk of postoperative adhesions with a pooled odds ratio of 1.74 (95% CI 1 respectively). ,10-2,78); 2.89 (95% CI 2.44-3.41) and 9.91 (95% CI 8.66-11.35). Intra-abdominal contamination also had a risk of adhesions with a pooled odds ratio of 863.47 (95% CI 177.73-4194.13).

**CONCLUSION:** Types of colorectal surgery : APR, total colectomy, and rectal resection and intra-abdominal contamination had a risk of postoperative adhesions.

**KEYWORDS :** colorectal surgery, intra-abdominal contamination, postoperative adhesions

### INTRODUCTION

Colorectal surgery is the highest incidence of adhesion-related problems. Types of colorectal surgery might be total colectomy, right hemicolectomy, left hemicolectomy, segmental colectomy, Hartmann procedure, and colostomy.

All of these surgical procedures performed on the colon could be contaminated with the most common contamination is faecal contamination.

Faecal contamination can irritate peritoneum as a foreign body. Various causes of peritoneal irritation result in localized fibrin production, which results in adhesion to the surfaces in contact<sup>1</sup>.

Small bowel adhesions are the most common cause of gastrointestinal obstruction, accounting for 40-80% of intestinal obstruction in western countries hospitalized patients<sup>2</sup>.

Small bowel adhesions can be occurred from first month after surgery to more than eight decades after surgery.

In this study, the authors focused on analyzing risk of colorectal surgery and intra-abdominal contamination on incidence of postoperative adhesions.

### Methods

This is systematic review and meta-analytical study, with retrospective cohort method. This study was conducted from July to September 2021.

Sample literature was taken from Cochrane, Pubmed, and Science Direct databases within last 10 years publication with case control and cohort type studies.

Keywords used were "adhesive bowel", "adhesive intestine", "open laparotomy", "open colorectal surgery", "open

colectomy", "open hemicolectomy", "total colectomy", "intraabdominal contamination", "bile spillage", "peritonitis", "intra-abdominal abscess", and "faecal contamination".

Data was extracted by three reviewers. Quality of journal was screened with NOS (The Newcastle Ottawa Scale) criteria and followed PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) diagram.

Meta-analysis was performed using Review Manager 5.4 software.

### Inclusion And Exclusion Criteria

Inclusion criteria in this study were English language studies, case control and cohort studies, discussed relationship between risk factors for type colorectal surgery and intra-abdominal contamination to incidence of post-abdominal adhesions, and were able to access the complete study.

Exclusion criteria were studies in languages other than English and only in the form of abstracts.

### Results

Literature search was performed on the Pubmed, Cochrane, and Science Direct search engines and found 17709 literatures.

These literatures consist of 3906 literatures from Cochrane, 4243 literatures from PubMed, and 9560 literature from Science Direct.

Flow of literature search is summarized in Figure 1. Obtained 22 literatures that match inclusion criteria.

We assessed literatures using modified Newcastle-Ottawa Scale (NOS) and obtained 22 journals for qualitative study and 10 journals for quantitative study.

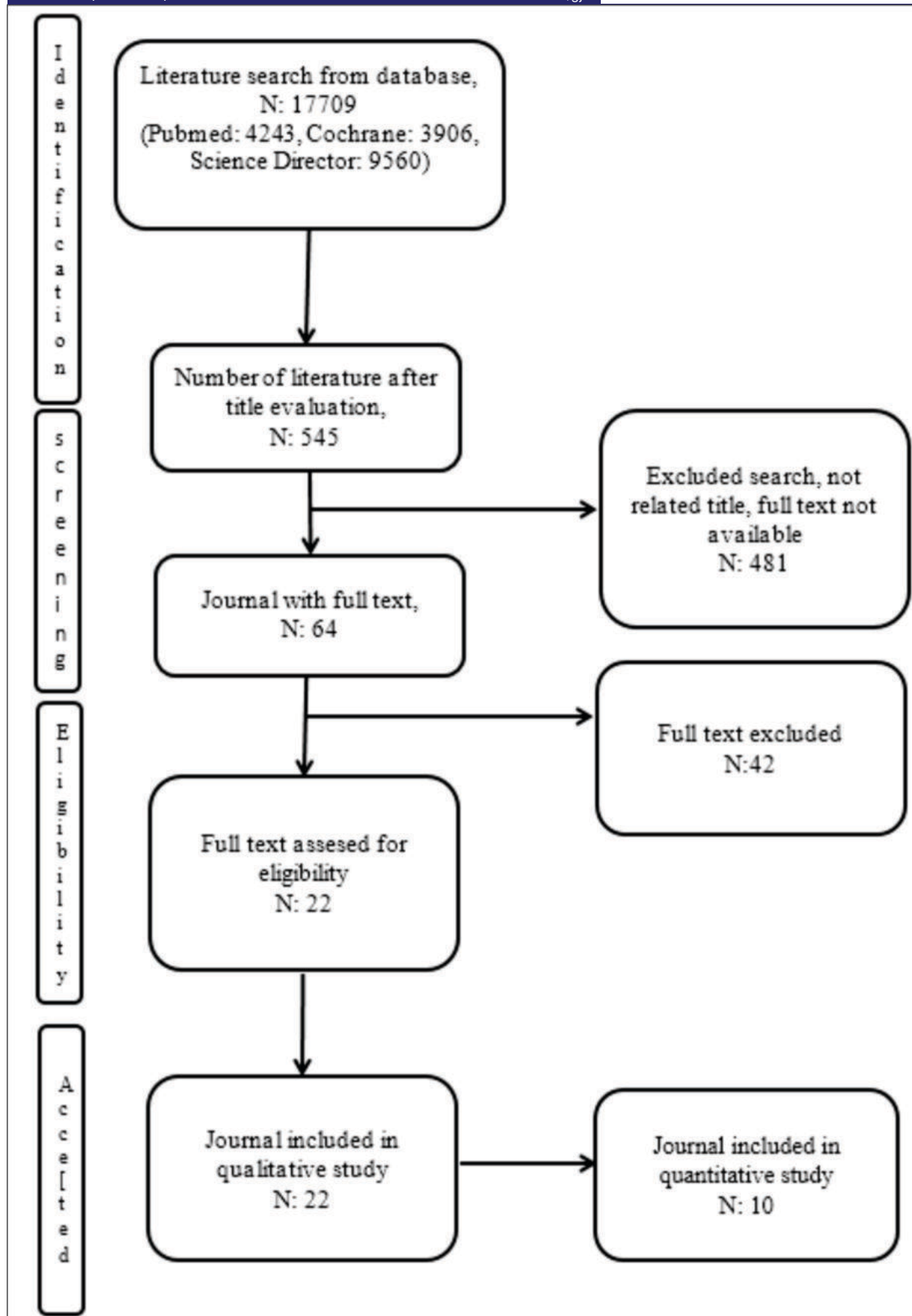


Figure 1 Diagram Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

#### Characteristics Of Study Literature

Table 1 presents characteristics of study literature. In this study,

22 literatures were obtained, 9 literatures with case control study designs and 14 literatures with cohort study designs.

**Table 1 Qualitative Systematic Study**

Name	Year	Design Study	Country	Title	Number of Patient	Adhesion Case	NOS
Angete	2012	Case Control	Sweden	Effect of Laparoscopy on the Risk of Small-Bowel Obstruction	4841	533	7
Andersen	2017	Cohort	Denmark	Nationwide population-based cohort study to assess risk of surgery for adhesive small bowel obstruction following open or laparoscopic rectal cancer resection	4472	249	8
Aquina	2015	Cohort	USA	Missed Opportunity: Laparoscopic Colorectal Resection Is Associated With Lower Incidence of Small Bowel Obstruction Compared to an Open Approach	51957	3565	7
Benlice	2015	Cohort	USA	Laparoscopic IPAA Is Not Associated With Decreased Rates of Incisional Hernia and Small-Bowel Obstruction When Compared With Open Technique: Long-term Follow-up of a Case-Matched Study	238	62	8
Bueno-lledo	2016	Case Control	Spain	Adhesive Small Bowel Obstruction: Predictive Factors of Lack of Response in Conservative Management with Gastrografin	98	98	7
Hashimoto	2012	Case Control	Japan	Clinical features of strangulated small bowel obstruction	9	9	7
Jordi	2017	Case control	Spain	Failure of conservative treatment with Gastrografin® for adhesive small bowel obstruction after colorectal surgery	187	187	8
Kang	2018	Cohort	Korea Selatan	Early postoperative small bowel obstruction after laparotomy for trauma: incidence and risk factors	67	17	7
Ki-Sang	2020	Case Control	South Korea	Feasibility of the Gastrografin Challenge for Adhesive Small Bowel Obstruction	8	8	7
Krielen	2020	Cohort	Scotland	Adhesion-related readmissions after open and laparoscopic surgery: a retrospective cohort study (SCAR update)	9139	951	8
Lili	2020	Cohort	China	Use of the Water-Soluble Contrast Medium Gastrografin in Treatment of Adhesive Small Bowel Obstruction in Patients with and Without Chronic Radiation Enteropathy: A Single-Center Retrospective Study	20	20	7
Mazetti	2017	case control	Belgium	Early laparoscopic adhesiolysis for small bowel obstruction: retrospective study of main advantages	30	30	7
Meier	2014	Cohort	Canada	Clinical Outcome in Acute Small Bowel Obstruction after Surgical or Conservative Management	49	49	7
Morawski	2015	Case control	Poland	Peritoneal adhesions as a cause of mechanical small bowel obstruction based on own experience	17	17	7
Nakamura	2016	case control	Japan	Laparoscopic Surgery is Useful for Preventing Recurrence of Small Bowel Obstruction After Surgery for Postoperative Small Bowel Obstruction	39	39	7
Reshef	2012	Cohort	USA	Risk of adhesive obstruction after colorectal surgery: the benefits of the minimally invasive approach may extend well beyond the perioperative period	190	26	7
Sakari	2020	Cohort	Sweden	Mechanisms of adhesive small bowel obstruction and outcome of surgery; a population-based study	110	110	7
Saklani	2012	Cohort	England	Adhesive intestinal obstruction in laparoscopic vs open colorectal resection	187	13	7
Smolarek	2016	Cohort	Italian	Small-Bowel Obstruction Secondary to Adhesions After Open or Laparoscopic Colorectal Surgery	529	52	7
Soo	2014	Cohort	South Korea	Early Postoperative Small Bowel Obstruction is an Independent Risk Factor for Subsequent Adhesive Small Bowel Obstruction in Patients Undergoing Open Colectomy	1002	70	9
Ten Broek	2013	Cohort	Netherlands	Adhesiolysis-Related Morbidity in Abdominal Surgery	341	219	9

Tunc	2014	case control	Turkey	Surgical indicators for the operative treatment of acutemechanical intestinal obstruction due to adhesions	48	48	7
Udelsman	2018	Cohort	USA	Population Level Analysis of Adhesive Small Bowel Obstruction	157403	16670	8

From 22 literatures, a total of 230981 patients were found and there were 23042 cases of adhesions after colorectal surgery. Only 14 journals describing type of colorectal surgery performed in detail. Types of colorectal surgery mentioned are anterior resection, abdominal perineal resection, rectopexy, colectomy, rectal surgery, colonic resection anastomotic and proctocolectomy. According to duration postoperative adhesion events, adhesions <1 year postoperatively occurred in 8493 patients, and the rest occurred >1 year.

### Quantitative Meta-analysis Study

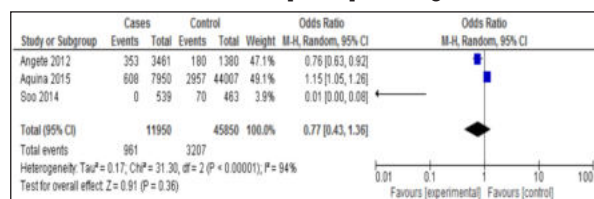
Eleven literatures<sup>3,4,5,6,7,8,9,10,11,12,13</sup> were included in quantitative meta-analysis study. Table 2 presents risk factors for colorectal surgery and intra-abdominal contamination, numbers of study for each risk factor, analytical model used, relative risk, confidence interval, p-value heterogeneity, and overall p-value (overall test).

**Table 2 Quantitative Meta-analysis Study**

Risk Factor	NS	Model	OR	CI 95%	pHET	P-value
Operation type : LAR	3	REM	0.77	[0.43-1.36]	P < 0.00001	P = 0.36
Operation type : APR	3	REM	1.74	[1.10-2.78]	P = 0.0002	P = 0.02
Operation type : total colectomy	2	REM	2.89	[2.44-3.41]	P = 0.22	P < 0.00001
Operation type : segmental colectomy	6	REM	1.31	[0.44-3.91]	P < 0.00001	P < 0.00001
Operation type : rektal resection	3	REM	9.91	[8.66-11.35]	P = 0.07	P < 0.00001
Intraabdominal Contamination	6	REM	863.4	[177.73-4195.13]	P = 0.11	P < 0.00001

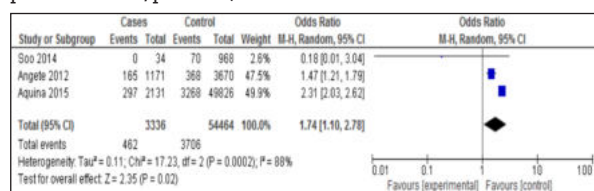
NS: Number of Study REM : Random Effect Model, FEM : Fixed Effect Model OR: Odds Ratio

CI: Confidence Interval 95%, pHET: p Heterogenitas



**Figure 2 Forest Plot Relationship Between Lar Surgery And Incidence Of Postoperative Adhesions**

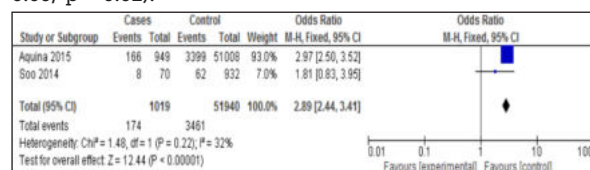
All journals<sup>3,4,5</sup> analyzed showed random-effect model resulted in pooled odds ratio of 0.77 [0.43, 1.36] and intersected vertical OR line number 1 so it was concluded patient with LAR surgery had no adhesion risk factor. There is no significant relationship between LAR surgery and incidence of adhesion (p value > 0.05, p = 0.36).



**Figure 3 Forest Plot Relationship Between Apr Surgery And Incidence Of Postoperative Adhesions**

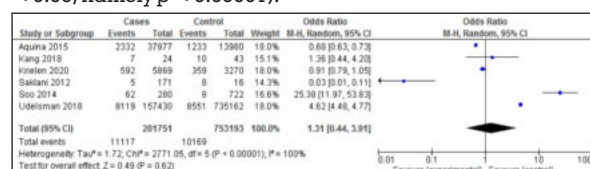
All journals<sup>3,4,5</sup> analyzed showed random-effect model

produced pooled odds ratio of 1.74 [1.10, 2.78] and did not cross vertical OR line number 1 so it was concluded patient with APR surgery had a 1.74 times greater risk of adhesion than other surgery. There is no significant relationship between APR surgery and incidence of adhesion (p value > 0.05, p = 0.02).



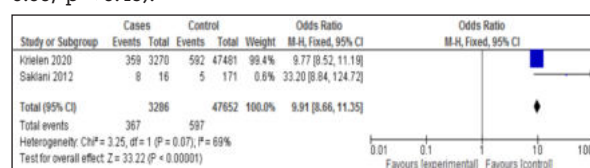
**Figure 4 Forest Plot Relationship Between Total Colectomy And Incidence Of Postoperative Adhesions**

All journals<sup>4,5</sup> analyzed showed that fixed-effect model resulted in pooled odds ratio of 2.89 [2.44, 3.41] and did not cross vertical OR line number 1 so it was concluded patients with total colectomy surgery had risk of adhesion 2.89 times greater than other surgery. There is a significant relationship between total colectomy surgery and incidence of adhesion (p < 0.05, namely p < 0.00001).



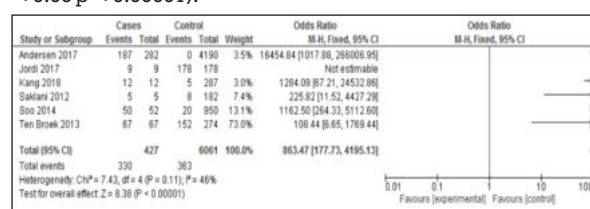
**Figure 5 Forest Plot Relationship Between Segmental Colectomy And Incidence Of Postoperative Adhesions**

All journals<sup>4,5,6,7,8,9</sup> analyzed showed that random-effect model resulted in pooled odds ratio of 1.31 [0.44, 3.91] and intersected vertical OR line number 1 so it can be concluded patients with segmental colectomy surgery are not risk factor for adhesion. There was no significant relationship between segmental colectomy surgery and incidence of adhesion (p > 0.05, p < 0.48).



**Figure 6 Forest Plot Relationship Between Rectal Resection And Incidence Of Postoperative Adhesions**

All journals<sup>7,12</sup> analyzed showed that fixed-effect model resulted in pooled odds ratio of 9.91 [8.66, 11.35] and did not cross the vertical OR line number 1 so it concluded patients with rectal resection had 9.91 times greater risk adhesions than other surgery. There is significant relationship between rectal resection surgery and incidence of adhesions (p-value < 0.05 p < 0.00001).



**Figure 7 Forest Plot Relationship Between Intra-abdominal Contamination And Incidence Of Postoperative Adhesion**



All journals<sup>5,6,10,11,12,13</sup> analyzed showed fixed-effect model produced pooled odds ratio of 863.47 [177.73, 4194.13] and did not cross vertical OR line number 1 so that it was concluded patients with intra-abdominal fecal contamination surgery had risk of adhesion 863.47 times greater than other surgery. There is significant relationship between intra-abdominal fecal contamination and incidence of adhesions (p value < 0.05, p < 0.00001).

## DISCUSSION

Purpose of this study was to identify risk factors for colorectal surgery and intra-abdominal contamination on the incidence of postoperative adhesions. One of risk factors, type of colorectal surgery, found that APR surgery, total colectomy and rectal resection had significant risk of postoperative adhesions with pooled odds ratio of 1.74 (95% CI 1.10-2, respectively). 78); 2.89 (95% CI 2.44-3.41) and 9.91 (95% CI 8.66-11.35). This is consistent with previous studies<sup>3,13,14</sup> that showed rectal surgery was the highest cause of postoperative adhesion related to hospital readmission rates. It has been suggested that adhesion formation after rectal surgery may be due to empty pelvic area after surgery<sup>15</sup>. A cohort study<sup>16</sup> conducted by Afshari also found that risk of obstruction after rectal cancer surgery was 11% and most patients were rehospitalized within first year after surgery.

Another risk factor studied in this study was intra-abdominal contamination, all journals<sup>5,6,10,11,12</sup> analyzed discussed relationship between between intra-abdominal contamination and incidence of postoperative adhesions with pooled odds ratio of 863.47 (95% CI 177.73-4194.13) and concluded that patients with intra-abdominal contamination had risk of adhesion of 863.47 times greater than without contamination. There was significant relationship between intra-abdominal contamination and incidence of adhesion, (p > 0.05, p = 0.11). This is consistent with Strik<sup>17</sup> where intestinal injury is a significant risk factor for the incidence of adhesions (p > 0.01).

Adhesions are caused by complex factors, such as mechanical or thermal injury, ischemia, abrasion, infection, local inflammation, endometriosis and foreign body reactions. Surgical trauma, hemostasis and pathogen contamination can progress to fibrin deposition and coagulation which have been identified as major causes of postoperative adhesions<sup>18</sup>.

## CONCLUSION

Types of colorectal surgery APR, total colectomy and rectal resection have risk of postoperative adhesions with pooled odds ratio of 1.74 (95% CI 1.10-2.78); 2.89 (95% CI 2.44-3.41) and 9.91 (95% CI [8.66-11.35] p<0.0001). Intra-abdominal contamination has risk of post colorectal adhesions with pooled odds ratio of 863.47 (95% CI [177.73-4194.13] p 0.01).

## Study Limitations

Further study should be carried with broader search, with use of large number databases and higher quality study.

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