

## Original Research Article

# Searching for the safest abdominal closure technique after emergency laparotomy for Hinchey III and IV peritonitis

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## ABSTRACT

**Background:** The optimal strategy for abdominal wall closure has been an ongoing issue of debate and convincing evidence is still lacking. The INLINE systematic review and meta-analysis published on *Annals of Surgery* 2010 suggested that a running suture with a slowly absorbable suture material was the gold standard technique for abdominal wall closure after elective surgery, while there's no general agreement in the emergency setting.

**Methods:** Retrospective study regarding patients who underwent emergency surgery for a generalized peritonitis due to colonic perforation from 2002 to 2014 at San Gerardo hospital (Monza, Italy). Particularly study analyzed differences between continuous suture (Maxon loop, Covidien ©) and interrupted suture (Safil, B. Braun ©) for fascial closure and between metallic clips and second intention healing for incision management. After completion of data retrieval, 110 patients were included in the statistical analysis.

**Results:** Incisional hernia rate was 15/101 (14.9%) and surgical site infection rate was 29/110 (26.4%). No significant statistical differences were found between incidence of incisional hernia and surgical site infection in the two groups, although there was a higher prevalence of incisional hernia in the running suture group (25% vs 11.7%). There was no difference between skin-stapler's and second-intention's wound closure groups in terms of surgical site infection and incisional hernia development.

**Conclusions:** We consider reasonable to use an interrupted long time absorbable suture for fascial closure after emergency midline laparotomy for Hinchey III and IV peritonitis, at least in high-risk patients. Considering skin closure, suggestion is to perform a primary skin closure.

**Keywords:** Abdominal wall closure, Emergency surgery, Interrupted, Peritonitis, Running

## INTRODUCTION

Even if not feared more than others dangerous surgical complications such anastomotic dehiscence or intraperitoneal haemorrhage, incisional hernia (IH) and surgical site infection (SSI) could strongly increase postoperative morbidity of patients who underwent abdominal surgical procedures. IH and SSI are strictly connected, they share patients' related risk factors, and

many authors consider wound infection as one of the most crucial factors contributing to incisional hernia development.<sup>1,2</sup>

During the last decade, the scientific community has produced many efforts to try to define a gold standard technique for abdominal wall closure.<sup>3</sup> The variety of available closure methods comprises of different suture materials (e.g. braided versus monofilament, rapidly,

slowly, and non-absorbable) and suture techniques (e.g. interrupted versus continuous) as well as the application of subcutaneous sutures, subcutaneous drains, and different methods of skin closure. Diener et al published The INLINE Systematic review and meta-analysis on elective midline laparotomy closure technique.<sup>4</sup>

Five systematic reviews and 14 trials including 7711 patients (6752 midline incisions) were analyzed and authors concluded that no further trials should be conducted for the evaluation of techniques and available materials for elective midline abdominal fascial closure, according to the results of cumulative meta-analysis. Running suture with a slowly absorbable suture material is nowadays the gold standard technique for abdominal wall closure after elective surgery.

If the INLINE study represents a cornerstone regarding elective setting as demonstrated in the recent guideline of the European Hernia Society, there is no accordance on emergency procedure and contaminated abdomens.<sup>5</sup> Trying to define the problem of abdominal wall closure after emergency surgery, Rahbari et al, designed the CONTINT study protocol (continuous versus interrupted abdominal wall closure after emergency midline laparotomy).<sup>6</sup> This RCT is still ongoing and results haven't been published yet.

The aim of this study was to evaluate the relationship between fascial and skin closure techniques and incidence of incisional hernia development and surgical site infection to delineate the optimal way to close abdominal wall in emergency settings with contaminated operatory field.

## METHODS

Retrospectively collected data regarding patients who underwent emergency surgery for a generalized purulent or fecal peritonitis due to colonic perforation between January 2002 and September 2014 at San Gerardo Hospital (Monza, Italy). Were excluded patients below 18 or above 99 years of age, patients with localized peritonitis (Hinchey class II or inferior) and generalized peritonitis due to perforation of any segment of the gastrointestinal tract, other than that of the large intestine.

A total number of 205 patients was initially selected, all surgical reports were screened searching for detailed description of fascial and skin closure surgical technique. Particularly, analyzed differences between continuous suture (Maxon loop, Covidien ©) and interrupted suture (Safil, B. Braun ©) for fascial closure and between metallic clips and 2<sup>nd</sup> intention healing for incision management.

Patients' pre-operative status was assessed based on the following issues: Age at the time of intervention; etiology of the perforation (confirmed by histology); comorbidities, as reported in the charlson comorbidity

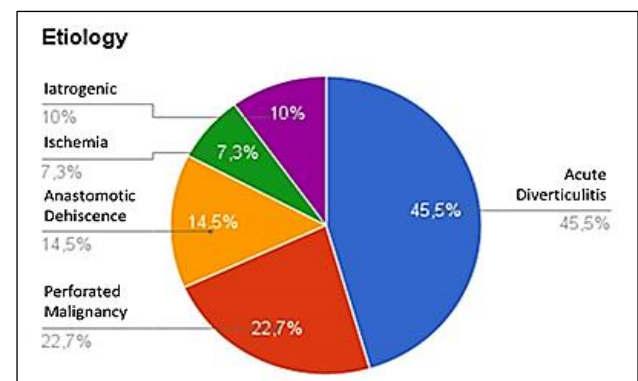
index (CCI) and charlson age-comorbidity index (CACI); white blood cells (WBC) count and C-reactive protein (CRP) levels (when available); presence of severe sepsis or septic shock, according to the definitions provided by the surviving sepsis campaign; pre-operative physiologic status, according to P- POSSUM score.<sup>7-10</sup>

Post-operative progress was assessed based on the Clavien-Dindo classification of surgical complications.<sup>11</sup> Surgical site infection was evaluated with postoperative in hospital and outpatient's clinical evaluation 7 and 30 days after hospital discharge.

Incisional hernia was evaluated by telephone interviews and in case of doubt with a clinical evaluation a la demand. No routine ultrasound evaluation has been performed. In case of IH development, timing of onset and timing of surgical correction (when occurred) were registered. If hernia was clinically detectable but patient refused surgical correction the motivation of denial was registered. After completion of data retrieval, 110 patients were included in the statistical analysis. Univariate statistical analysis was carried out using the following descriptive statistics: absolute numbers and proportions for categorical variables; Median and interquartile range for continuous variables.

For the former, the Fisher exact test was used to test the association with the outcomes; for the latter, the Mann-Whitney U test was adopted, due to the nonnormal-shaped distribution of the variables. All the analyses were carried out using the R software version 3.2.2. and p values <0.05 were considered significant.

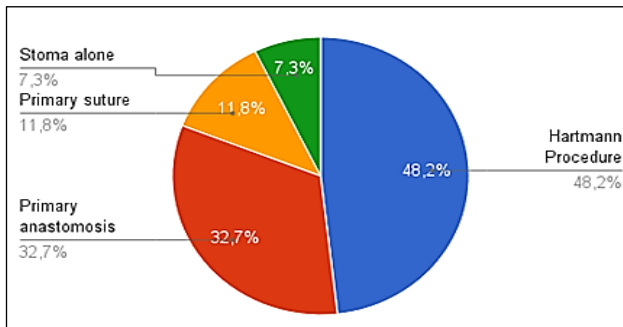
## RESULTS



**Figure 1: Causes of generalised peritonitis in patients who underwent emergency surgery.**

110 patients with colonic perforation and consequent acute peritonitis were included in the study. In Figure 1 causes of perforation were summarized, while in Figure 2 reported type of surgical procedure performed. Most patients suffered from acute perforated diverticulitis (45,5%) or malignancy (22,7%) and the most performed procedures were Hartmann procedure (HP) (48,2%) and

colonic resection with primary anastomosis with or without protective stoma (32,7%).



**Figure 2: Different type of surgical procedures patients who underwent emergency laparotomy for generalised peritonitis.**

Postoperative outcomes different from surgical site infection, incisional hernia and burst abdomen were not considered for this study. Incisional hernia incidence rate in the series was 14.9%, burst abdomen rate was 3.7%.

9/110 patients were lost at long term follow up for incisional hernia development, so they were excluded from statistical analysis about incisional hernia incidence. Superficial surgical site infection occurred in 26.4% of patients. Baseline characteristics of the study population were summarized in Table 1.

**Table 1: Baseline characteristics of study population.**

Characteristics	
Sex (M)	45/110 (40,9%)
Age (years)	65.5 ±15.4
CCI	2 (0-12)
CACI	5 (0-15)
Malignancy	37/110 (33.6%)
Severe sepsis/shock	16/110 (14.5%)
Hinchey IV	51/110 (46.4%)
OR times (minutes)	172 ±69
Follow up duration (months)	19.2 (1-148.3)
Incisional hernia	15/101 (14.9%)
Burst abdomen	3/110 (3.7%)
SSI	29/110 (26.4%)

**Table 2: Correlation between fascial closure technique and incisional hernia development.**

	Running suture	Interrupted suture	P-values
Sex (M)	11/24 (45.8%)	32/77 (41.6%)	0.712
Age (years)	66±14.9	65±15.1	0.737
CCI	3 (0-12)	3 (0 - 12)	0.209
CACI	5 (0-15)	5 (0 - 15)	0.466
Malignancy	9/24 (37.5%)	23/77 (29.8%)	0.483
Severe sepsis/shock	6/24 (25%)	8/77 (10.4%)	0.071
OR times (minutes)	155± 449.6	177 ±73	0.173
Hinchey IV	14/24 (58.3%)	35/77 (45.5%)	0.27
Incisional hernia	6/24 (25%)	9/77(11.7%)	0.109
Burst abdomen	1/24 (4.2%)	2/77 (2.6%)	0.693
SSI	7/24 (29.2%)	20/77 (26%)	0.758
Incisional hernia + SSI	3/24 (12.5%)	2/77 (2.6%)	0.051

**Table 3: Correlation between skin closure technique and surgical site infection development.**

	Primary skin closure	2 <sup>nd</sup> intention closure	P-values
Sex (M)	29/71 (40,8%)	16/39 (41%)	0.99
Age (years)	67±15.4	62.6±15.1	0.15
CCI	3 (0 - 12)	3 (0 - 12)	0.383
CACI	5 (0 - 15)	5 (0 - 15)	0.903
Malignancy	19/71 (26.8%)	18/39 (46.2%)	0.06
Severe sepsis/shock	7/71 (9.9%)	9/39 (23.1%)	0.11
OR times (minutes)	168±66	178±74	0.493
Hinchey IV	25/71 (35.2%)	26/39 (66.6%)	0.003
Incisional hernia	10/71 (14.1%)	5/39 (12.8%)	0.853
Burst abdomen	2/71 (2.8%)	1/39 (2.6%)	0.94
SSI	15/71 (21.1%)	14/39 (35.9%)	0.93
Incisional hernia + SSI	3/64 (4.7%)	2/37 (5.4%)	0.873

Study reported in Table 2 and 3 correlations between abdominal wall closure technique and SSI and IH development. The study groups were comparable for baseline characteristics except for a significant trend in favour of second intention wound healing over primary skin closure in Hinchey IV peritonitis (66.6% versus 35.2%).

## DISCUSSION

The applied surgical strategy for abdominal wall closure (result from the combination of suture technique and material) is of high relevance for the prevention of fascial dehiscence and, moreover, constitutes the main factor directly controllable by the surgeon.

However, a recent cross-sectional study among surgeons participating in a large multicenter trial revealed a lack of consensus regarding abdominal wall closure strategies.<sup>3</sup>

This heterogeneity of behavior has led many authors to standardize abdominal wall closure procedures.<sup>4,6</sup> If the process of standardization has achieved satisfactory results in the elective surgery setting as demonstrated by recent international guidelines of the European hernia society with the introduction of globally accepted slowly absorbable running suture as gold standard for abdominal wall closure, shortage of solid evidence leaves the emergency setting an unexplored field.<sup>5</sup>

Another controversial argument is represented by safer technique and material used for skin closure after contaminated/dirty abdominal surgery, present literature remains nowadays inconclusive and lacks strong evidences.

The adverse impact of emergency surgery on the incidence of postoperative complications as compared to an elective setting has already been demonstrated in numerous studies.<sup>12-14</sup>

Reasons for this difference include factors such as a contaminated operative field, poor general conditions of these patients and different requirements to the abdominal wall, especially in patients requiring prolonged mechanical ventilation. The proliferation of bacteria in tissue represents a strong risk factor causing wound infection with delayed healing of the wound or wound dehiscence. Study consider Hinchey III and IV peritonitis caused by colonic perforation the ideal setting of patients to study the influence of surgical technique and material adopted over incisional hernia and SSI development rate.

Considering study data, no significant statistical difference was found in the incidence of incisional hernia development, neither at very early (evisceration) or long-time evaluation. Even if data collected about this outcome doesn't reach a statistical validation we noted a strong trend in favour of interrupted over running suture

in terms of incisional hernia development. (11,7% versus 25% p 0,109).

If considering incisional hernia, the two groups analyzed were well matched for baseline characteristics, however we noted a bias in the distribution of patients among the two-different group analyzing skin closure technique. In Hinchey IV peritonitis in fact surgeons seem to prefer second intention wound healing over primary closure (66,6% versus 35,2% p 0,003).

In study case series, no difference was evidenced in SSI rate between primary and second intention wound healing group (21,1% versus 35,9% p 0,93). The selection bias described before could explain the strong trend observed in favour of primary skin closure, in fact delayed wound healing is reserved for more contaminated procedures with higher risk of surgical site infection development.

Only 5 patients in front of 101 suffered for SSI and IH simultaneously, and no correlation was identified between surgical infection and hernia development as supposed by many authors considering subcutaneous tissue inflammation as the first step leading to non-optimal fascial layer consolidation and consequent hernial defect formation.

Moreover, according to study data, we recommend the use of an interrupted suture for fascia closure after emergency laparotomy in elevated risk patient treated for Hinchey III and IV peritonitis.

According to described follow up, 8/15 (53,3%) patients with diagnosis of incisional hernia underwent surgical procedure to correct fascial defect. In remaining patients, incisional hernia was not corrected because of age, comorbidity, systematicity or other personal reasons.

Primary skin closure with metallic agraphes is not inferior to second intention wound healing in reducing SSI after peritonitis due to colonic perforation, according to presented data primary intention skin closure can be performed extensively to offer patients a better postoperative aesthetic outcome without increasing wound infection risk.

This study presents several limitations. Firstly, the study is conducted retrospectively and sample size is limited. The study examines a restricted cohort of patient (Hinchey III and IV peritonitis due to colonic perforation) and a limited event among this cohort (Incisional Hernia 14,9% and SSI 26,4%), for these reasons conducting a well-designed study about these outcomes in emergency setting is very challenging.

Even if follow up duration in this study is longer than in similar series (usually only 12 months), we didn't perform a routine imaging evaluation in all patients, reserving ultrasound examination only for uncertain

cases. This could probably underestimate the real incidence of incisional hernia.

Finally, because of the retrospective nature of follow up, we cannot provide certain information about incisional hernia development timing.

## CONCLUSION

According to presented data we consider reasonable the use of an interrupted long time absorbable suture for fascial closure after emergency midline laparotomy for Hinchey III and IV peritonitis, at least in high-risk patients.

Considering skin closure, we didn't find any advantages in leaving the wound healing for second intention in terms of surgical site infections reduction, study suggestion is to perform a primary skin closure with metallic agraphes or interrupted non-absorbable suture and eventually reserve second intention wound healing in those patients who develop postoperative infection of surgical wound.

Randomized controlled trials are necessary to define a gold standard technique for abdominal wall closure even in this special cohort of patients, results of the CONTINT trial could probably add some valuable information about this discussed topic.

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