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Original research

Fascial closure after open abdomen: Initial indication and early revisions are decisive factors – A retrospective cohort study

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HIGHLIGHTS

- Initially performed open abdomen increases rates of fascial closure later on.
- Early second and third look operations increase rates of fascial closure.
- The surgeons' initial decision for open abdomen and early reoperations are decisive.
- The surgical treatment strategy is more important than the preoperative conditions of the patients.
- The presence of pancreatitis is the only negative prognostic marker.

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ABSTRACT

Background: The surgical treatment method in which the peritoneal cavity is opened anteriorly and deliberately left open, hence often called "open abdomen" has become the standard of care in damage-control procedures as well as in the management of intra-abdominal hypertension and in severe intra-abdominal sepsis. Whereas open abdomen has been closed in two stages traditionally, a modern trend is to close the fascial layers within the initial hospitalization to avoid complications like enterocutaneous fistula and hernia formation. The aim of this study was to determine crucial factors influencing the possibility of fascial closure after open abdomen. **Methods**: Between 2003 and 2013, 355 adult patients were treated with open abdomen in our institution. Their data were collected and retrospectively analyzed. They were divided into two groups depending on fascial closure or not (fascial closure, $n = 137$ (39%) vs. non-fascial closure, $n = 218$ (61%)). **Results**: The patients who reached fascial closure had a significantly higher rate of initially performed open abdomen (97 patients (71%) vs. 118 (54%), $p = 0.002$) and the periods of time until a second and a third look operation were significantly shorter (2.7 ± 2.5 vs. 4.2 ± 6.6 days, $p = 0.021$ and 5.6 ± 3.7 vs. 8.5 ± 8.6 days, $p = 0.006$). Furthermore, the presence of peritonitis (64 patients (47%) vs. 83 patients (38%), $p = 0.023$) and large bowel resection (74 patients (54%) vs. 90 patients (41%), $p = 0.022$) were significantly higher in this group. Rates of in-hospital mortality (97 patients (44%) vs. 38 patients (28%), $p = 0.002$) and the presence of pancreatitis (19 patients (9%) vs. 3 patients (2%), $p = 0.013$) were significantly higher in the non-fascial closure group. **Conclusions**: The probability to reach fascial closure after open abdomen seems to increase when open abdomen is performed initially and when early second and third look operations are performed. The presence of pancreatitis seems to be the only negative prognostic marker concerning fascial closure.

1. Introduction

The surgical treatment method in which the peritoneal cavity is opened anteriorly and deliberately left open, hence often called "open abdomen" has become the standard of care in damage-control procedures as well as in the management of intra-abdominal hypertension and in severe intra-abdominal sepsis

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[1–4]. Many studies report mortality rates of patients treated this way exceeding 30% [5–9].

Traditionally, open abdomen has been closed in two stages: primarily with granulation tissue or a free skin graft and later with abdominal wall reconstruction. A modern trend is to close the fascial layers within the initial hospitalization [10]. However, in a relevant number of cases, initial fascial closure is not possible due to ongoing visceral edema, loss of the peritoneal domain or lateral retraction [11].

Especially in these cases in which the patient is left with an open abdomen, complications like fluid and electrolyte disorders and the development of enterocutaneous fistula gain importance. Furthermore, a "planned ventral hernia" is created which has to be corrected at a later stage. Although surgical correction of these ventral hernia is possible, it is a higher risk operation and recovery frequently takes several months [12]. Thus, early definitive fascial closure is the basis of preventing and reducing the risk of these complications occurring after open abdomen [1].

The aim of this study was to determine crucial factors influencing the possibility of fascial closure within the initial hospitalization after open abdomen. We therefore analyzed all adult patients treated with open abdomen in our institution during the last eleven years. We investigated the preoperative status, the operative details and the postoperative course of these patients. The special group of premature infants with open abdomen was excluded and separately analyzed [13].

2. Materials and methods

Clinical data of all adult patients who were treated with open abdomen in our institution between 2003 and 2013 were collected and retrospectively analyzed. In all cases, open abdomen was performed with an absorbable Vicryl mesh which was placed as an inlay to bridge the fascia after laparotomy. Patients were divided into two groups depending on fascial closure or not.

We distinguished between preoperative-, operative- and postoperative details (Tables 1–3). Regarding the preoperative data, we evaluated the patients' status, preexisting diseases and previous surgical treatment (Table 1). Investigating the operative details, indication of surgery and the presence of intraabdominal abscess formation or peritonitis was documented. We also determined kind and extent of bowel resection and the necessity of enterostomy. Time until open abdomen and second or third look operations was documented. In the group of patients without initial fascial closure, management of open abdomen like skin closure, granulation tissue or free skin graft was documented (Table 2). Postoperatively, in-hospital mortality rates, complications like enterocutaneous fistula, the number of operative revisions, time of artificial ventilation and the length of intensive care unit- (ICU) and in-hospital stay were included (Table 3).

Table 1
Preoperative data.

	Fascial closure $n = 137$ (39%)	Non-fascial closure $n = 218$ (61%)	p-value	Total $n = 355$ (100%)
Gender				
- Male	74 (54%)	123 (56%)	$p = 0.663$	197 (55%)
- Female	63 (46%)	95 (44%)		158 (45%)
Age in years	60 ± 17	62 ± 15	$p = 0.556$	61 ± 16
BMI in kg/m^2	27 ± 7	28 ± 8	$p = 0.589$	27 ± 8
ASA	3 ± 1	3 ± 1	$p = 0.292$	3 ± 1
Diabetes	16 (12%)	25 (11%)	$p = 1.000$	41 (12%)
Mycardial disease	41 (30%)	63 (29%)	$p = 0.905$	104 (29%)
Hypertension	63 (46%)	95 (44%)	$p = 0.663$	158 (45%)
COPD	20 (15%)	29 (13%)	$p = 0.753$	49 (14%)
Anemia	36 (26%)	64 (29%)	$p = 0.547$	100 (28%)
Renal insufficiency	31 (23%)	35 (16%)	$p = 0.126$	66 (19%)
Previous surgical treatment	107 (78%)	176 (81%)	$p = 0.588$	283 (80%)

Table 2
Operation details.

	Fascial closure $n = 137$ (39%)	Non-fascial closure $n = 218$ (61%)	p-value	Total $n = 355$ (100%)
Ileus	21 (15%)	32 (15%)	$p = 0.879$	53 (15%)
Malignancy	31 (23%)	61 (28%)	$p = 0.320$	92 (26%)
Trauma	6 (4%)	15 (7%)	$p = 0.366$	21 (6%)
Pancreatitis	3 (2%)	19 (9%)	$\mathbf{p = 0.013}$	22 (6%)
Anastomotic leakage	25 (18%)	41 (19%)	$p = 1.000$	66 (19%)
Intraabdominal abscess	19 (14%)	23 (11%)	$p = 0.399$	42 (12%)
Peritonitis	64 (47%)	83 (38%)	$\mathbf{p = 0.023}$	147 (41%)
MPI	27 ± 7	27 ± 7	$p = 0.664$	27 ± 7
Small bowel resection	66 (48%)	107 (49%)	$p = 0.913$	163 (46%)
Large bowel resection	74 (54%)	90 (41%)	$\mathbf{p = 0.022}$	164 (46%)
Stoma small bowel	34 (25%)	50 (23%)	$p = 0.702$	84 (24%)
Stoma large bowel	45 (33%)	58 (27%)	$p = 0.230$	103 (29%)
Blood transfusion intraoperatively	56 (41%)	79 (36%)	$p = 0.432$	135 (38%)
Intraoperative shock	25 (18%)	53 (24%)	$p = 0.190$	78 (22%)
Initial open abdomen	97 (71%)	118 (54%)	$\mathbf{p = 0.002}$	215 (61%)

P-values < 0.05 were considered to be significant.

Table 3
Postoperative course.

	Fascial closure $n = 137$ (39%)	Non-fascial closure $n = 218$ (61%)	p-value	Total $n = 355$ (100%)
Blood transfusion postoperatively	98 (72%)	145 (67%)	$p = 0.349$	243 (68%)
Hospital stay in days	44 ± 38	43 ± 39	$p = 0.773$	44 ± 38
ICU stay in days	23 ± 23	22 ± 22	$p = 0.860$	23 ± 22
In-hospital mortality	38 (28%)	97 (44%)	$\mathbf{p = 0.002}$	135 (38%)
Artificial ventilation in hours	366 ± 518	347 ± 436	$p = 0.497$	354 ± 469
Days until second-look	2.7 ± 2.5	4.2 ± 6.6	$\mathbf{p = 0.021}$	3.5 ± 5.2
Days until third-look	5.6 ± 3.7	8.5 ± 8.6	$\mathbf{p = 0.006}$	7.3 ± 7.1
Renal insufficiency	49 (36%)	90 (41%)	$p = 0.317$	139 (39%)
Number of revisions	3 ± 2	3 ± 2	$p = 0.164$	3 ± 2
Enterocutaneous fistula	10 (7%)	15 (7%)	$p = 1.000$	25 (7%)

P-values < 0.05 were considered to be significant.

2.1. Statistical analysis

Statistical analysis was carried out using the Statistical Package for Social Sciences software (SPSS®, Vers.17.0, Chicago, IL, USA). Differences between study groups were analyzed by Kruskal–Wallis test for non-parametric data and in case of significant differences confirmed by Mann–Whitney test. For numeric data