Advances in colorectal surgery
Wind, J.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Chapter 11

Single-stage closure of enterocutaneous fistula and stomas in the presence of large abdominal wall defects using the components separation technique

J Wind
PJ van Koperen
JFM Slors
WA Bemelman

American Journal of Surgery, in press
Abstract

Introduction
Closure of an enterocutaneous fistula and/or stomas in the presence of large abdominal wall defects is a challenging problem. In the present study the results of the components separation technique are described.

Methods
All patients with an enterocutaneous fistula and/or stomas in the presence of large abdominal wall defects (i.e. laparostomy of ventral hernia) who underwent a single-stage repair using the components separation technique in the period from January 2000 to July 2007 were reviewed retrospectively.

Results
A total of 32 patients were included. Median operating time was 204 minutes (range 87-573). In 18 patients, additionally to the components separation, an absorbable mesh was used. Postoperatively, in 16 patients 22 complications were reported. There were nine patients with local wound problems. Median postoperative hospital stay was 12 days (range 5-74). Seven patients developed a ventral hernia. Four of them were small asymptomatic recurrences. Four out of the 15 patients with an enterocutaneous fistula developed a recurrent fistula. Median follow-up was 20 months (range 3-54).

Conclusion
Closure of enterocutaneous fistula and/or stomas and simultaneous repair of large abdominal wall defects is feasible using the components separation technique but morbidity is considerable. Early recurrence of abdominal hernia and fistula is acceptable.
Introduction

Patients surviving intra-abdominal catastrophes frequently have large abdominal wall defects. These defects are generally the result of open abdomen management for severe intra-abdominal sepsis, trauma, or other abdominal emergencies. These large defects are often associated with enterocutaneous fistula and stomas.\textsuperscript{1} Closure of enterocutaneous fistula and/or stomas and simultaneous closure of the large and contaminated abdominal wall defect requires major surgery that includes extensive adhesiolysis, bowel resection with reanastomosing, and closure of the abdominal wall. Morbidity and mortality rates are high in these often malnutritioned patients, particularly those with high-output enterocutaneous fistula.\textsuperscript{2,3} The actual timing of the operation requires thoughtful consideration. Planning the operation too soon may result in an extremely difficult surgical procedure in an often fragile patient. Postponing the operation for too long exposes the patient unnecessarily to the deleterious metabolic effects of the fistula and catheter-related morbidity in case of parenteral nutrition.\textsuperscript{2,3}

Ideally, a non-absorbable mesh is used to close the abdominal wall because primary fascial closure is rarely possible in these patients.\textsuperscript{4} This technique ensures durable abdominal wall prosthesis. However, the application of a non-absorbable mesh is associated with an increased risk of infection, especially when used in a contaminated surgical field, for instance in the presence of enterocutaneous fistula and stomas.\textsuperscript{5,6} Furthermore, the implanted mesh might damage exposed bowel if the peritoneum or greater omentum are not interposed between the mesh and the bowel. Therefore, many surgeons are reluctant to use non-absorbable meshes in these complicated abdominal wall defects.\textsuperscript{5-7} The use of an absorbable mesh avoids infectious complications, but is only for temporary closure of the hernia.

The most logical alternative for these large and contaminated abdominal wall defects is the use of autologous tissue repair including local tissue repair, autologous grafts and pedicled or free vascularised flaps. In a recently published systematic review several techniques for autologous repair of abdominal wall defects were reviewed.\textsuperscript{8} Despite the poor quality of the included studies the components separation technique was the best documented procedure. This technique, for the repair of large ventral hernias, was first described by Ramirez et al.\textsuperscript{9} The separation of the muscle components of the abdominal wall allows local advancement with complete continuity of the released muscle layers over a greater distance compared to mobilisation of the entire abdominal wall as a block. This enables closure of large abdominal wall defects under contaminated circumstances avoiding mesh infection. Nevertheless, most of the studies included in the review concerned only clean or clean-contaminated surgical fields.\textsuperscript{8}

The aim of this study was to evaluate the results of closure of enterocutaneous fistula and/or stomas and simultaneous abdominal wall repair using the components separation technique.
Methods

The present study consists of a consecutive series of patients with enterocutaneous fistula and/or stomas in the presence of a large abdominal wall defect (i.e. laparostomy or ventral hernia). Patients had a single-stage closure of the enterocutaneous fistula and/or stomas and simultaneous repair of the abdominal wall using the components separation technique as described by Ramirez et al. All operations were performed electively in the period from January 2000 to July 2007. Data were assessed in a retrospective manner. Patients under 18 years of age, large abdominal wall defects without the presence of enterocutaneous fistula and/or stomas (i.e. surgical field contamination) and multi-staged procedures were excluded from this study. Charts of the included patients were reviewed and the following data were extracted using a preformatted sheet including age, gender, co-morbidity and surgical history, Body Mass Index (BMI, kg/m²), signs of malnutrition defined as a weight reduction of more than 10% in the previous six months and a low albumin level (< 30 g/l), ASA classification, reasons for surgical field contamination, operating time, concomitant surgical procedures, the use of mesh reinforcement, intra-operative morbidity, 30-day morbidity and mortality, postoperative hospital stay, readmissions and reoperations within 30 days. During long term follow-up recurrence of enterocutaneous fistula or the development of ventral hernia was assessed. Outcome and complications were noted during clinical and out-patient clinic follow-up.

Operative procedures

All patients underwent general anesthesia and received preoperative parenteral antibiotic prophylaxis (Ceforoxim 1500 mg/Clindamycine 600 mg, 30 minutes before surgery). When the procedure lasted for more than four hours the same antibiotic prophylaxis was repeated. Normal body temperature was maintained with standard bair hugger warming. Perioperative glucose levels were not checked routinely. To avoid inadvertent bowel injury, the abdomen was generally entered by dissecting the stomas when present. Otherwise the laparotomy was started at the upper border of the incisional hernia or at the midline above the laparostomy. A complete adhesiolysis was generally performed to get a clear view on the anatomy and to free the bowel from the abdominal wall. If enterocutaneous fistulas were present the segment(s) from which the fistula arose was identified and isolated followed by a limited resection and reanastomosing of the two segments. If stomas were present the bowel was reanastomosed and the fascia was closed using PDS 1 (Ethicon®) or the fascia was closed with a Vicryl mesh. Care was taken to reposition the anastomosis or sutured small bowel lesions that occurred during adhesiolysis, as far away from the abdominal wall as possible. The subsequent abdominal wall closure was performed using the components separation technique (Figure 1 and 2). The skin and subcutis were separated from the underlying abdominal musculature in lateral direction up to the anterior axillary line. Next the aponeurosis of the external oblique muscle was incised pararectally. Subsequently, the external oblique muscle was separated from the underlying internal oblique muscle by blunt dissection in a relatively avascular plane.
Figure 1. Cross-sectional view. Skin and subcutaneous tissue are separated from the underlying abdominal muscle in lateral direction up to the anterior axillary line. Next the aponeurosis of the external oblique muscle is incised pararectally and the external oblique muscle is separated from the underlying internal oblique muscle by blunt dissection (A and B). Additionally, the rectus muscle is separated from the posterior rectus sheath (C).
This was followed by the separation of the rectus muscle from the posterior rectus sheath. The separation of the muscle components of the abdominal wall allowed mobilisation of each unit over a greater distance with less tension. Subsequently the abdominal wall was closed using PDS 1. Sometimes a temporary reinforcement consisting of an onlay Vicryl mesh was sutured to the fascia. The skin was closed with running sutures. Two suction drains were routinely used between the mobilised skin and abdominal wall musculature to drain the death space. The skin was closed because leaving the skin open would not guarantee adequate drainage (via the suction drains) of the large subcutaneous wound surfaces. Therefore, skin closure combined with closed wound drainage (suction drains) was preferred. Postoperatively, no abdominal binders were applied routinely. In case of a wound infection the running sutures were (partly) removed for adequate drainage.

**Statistics**

Data are presented as median values with ranges for continuous data, unless otherwise specified. Categorical data are presented as number of patients and percentages. The Chi-square or Fisher’s exact test was used to test for differences between groups. A p-value <0.05 was considered statistically significant. Statistical analysis was done using the SPSS v.12.0 package (SPSS, Chicago, Illinois, USA).
Results

Demographics of the included patients
In the study period a total of 32 patients were identified who underwent single-staged closure of enterocutaneous fistula and/or stomas and simultaneous repair of the abdominal wall using the components separation technique. There were 10 female and 22 male patients with a median age of 43 years (range 19-78), median BMI of 21.7 kg/m² (range 16-32) and a median ASA score of two (range 1-4). In nine (28%) patients there was malnutrition (weight reduction of more than 10% in the previous six months and a low albumin level) preoperatively. All patients were survivors of intra-abdominal catastrophes. In 22 (69%) patients an intra-abdominal sepsis was managed with an open abdomen. In the remaining patients a large incisional hernia was present expanding to at least half way the upper and lower abdomen. In Table 1 the reasons for the surgical field contamination are summarized. In four (13%) patients there was one source of contamination, in the remaining patients there were several sources. There were 15 (47%) patients with an enterocutaneous fistula of which nine were high output fistulas (>500 ml/24 hours). The origin of the fistula was a small bowel segment in 12 patients and in three patients the fistula arose from the large bowel. In 21 (66%) patients a stoma was closed comprising of 15 ileostomies and six colostomies. Furthermore, 22 patients had large contaminated granulating defects (i.e. laparostomy)

Table 1. Reasons for contamination of the surgical field

<table>
<thead>
<tr>
<th>Reason for contamination</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granulating defect (laparostomy)</td>
<td>22</td>
</tr>
<tr>
<td>Osteomy closure</td>
<td>21</td>
</tr>
<tr>
<td>Enterocutaneous fistula closure</td>
<td>15</td>
</tr>
<tr>
<td>Concomitant bowel resection†</td>
<td>9</td>
</tr>
<tr>
<td>Abscess</td>
<td>2</td>
</tr>
</tbody>
</table>

†Apart from resections of bowel segments from which the fistula arose in case of enterocutaneous fistula closure.

Operative data
Median operating time was 204 minutes (range 87-573). In five patients complete fascial approximation was not possible. In all these patients a Vicryl mesh was implanted. Additionally, in 13 patients the components separation was reinforced with a Vicryl mesh. This was done as an onlay procedure.
Concomitant bowel resections, apart from resections of bowel segments from which an enterocutaneous fistula arose, were necessary in nine patients; one patient underwent small and eight underwent large bowel resection(s). Furthermore, 21 patients underwent stoma closure, 15 patients underwent closure of one or more enterocutaneous fistulas. In three patients a stoma was constructed, two patients underwent a cholecystectomy, in two patients an abscess was drained and in one patient an entero-vesico fistula was closed.
Short term outcome
There was no postoperative mortality. Postoperatively, in 16 (50%) patients 22 complications were reported within the first 30 days. There were nine patients with local wound problems; eight patients had a wound infection and one patient had a large hematoma. One of these patients underwent a surgical debridement and drainage of the wound. Furthermore, five patients had a cardiopulmonary complication, three patients had a urine tract infection, two patients had a prolonged postoperative ileus, two patients had intra-abdominal abscesses which were drained radiologically and one patient developed an enterocutaneous fistula within the first 30 days. The local wound problems were not correlated with the type of contamination (i.e. stoma or enterocutaneous fistula), with the presence of an open abdomen or with the use of a Vicryl mesh.

Median postoperative hospital stay was 12 days (range 5-74). Three patients were readmitted within the first 30 days. Reasons for these readmissions were; a recurrent fistula, a wound infection, and dehydration due to nausea and vomiting.

Long term outcome
Four patients were lost to long term follow-up. No recurrent ventral hernia was found during their median follow-up of 3.5 months (range 1-8). Median follow-up of the remaining 28 patients was 20 months (range 3-54). Seven (25%) patients developed a recurrent ventral hernia. Of the seven patients with a recurrence four had Vicryl mesh reinforcement and in three patients the fascia could not be closed entirely during the components separation. There was no correlation between recurrence and postoperative wound infection. Two out of the eight patients with a wound infection had a recurrence compared to five out of the 24 patients without a wound infection. Four recurrences were small and asymptomatic which did not require repair. Three patients underwent an uncomplicated mesh repair. However, two of these patients developed a second recurrence and underwent a new mesh repair.

Four (27%) out of the 15 patients with an enterocutaneous fistula developed a recurrent fistula after a median of four months (range 0-15). In one of the patients with a recurrence after 15 months the fistula was due to activity of Crohn’s disease. Two patients had a reoperation for their enterocutaneous fistula. In one patient a recurrent fistula was excised without further recurrences. The second patient underwent three more operations due to recurrent fistula (last operation August 2007). A Munchausen syndrome was suspected in this patient.

Discussion
Closure of enterocutaneous fistula and/or stomas in the presence of large abdominal wall defects is a challenging problem. The primary goal of surgery is to close the enterocutaneous fistula or stoma. The presence and simultaneous management of a large abdominal defect is an accompanying problem making the combined procedure more difficult.
the event that the abdominal reconstruction fails due to wound infection, burst abdomen or infected prosthetic material, a laparostoma reoccurs with a high likelihood of intestinal fistulisation. The results of the present study demonstrated that single-stage management using the components separation technique is a feasible method avoiding early abdominal wall dehiscence. Nevertheless, the incidence of postoperative morbidity was high mainly due to wound infection. This is not surprising considering the contaminated condition and the large wound surfaces.

Mesh repair is superior to suture repair without prosthetic material with respect to the recurrence of hernia. After primary repair, rates of recurrences are reported up to 50 percent. Repairs that include the use of a mesh have recurrence rates ranging between zero and 25 percent. The morbidity rate for mesh repair in these none contaminated incisional hernias is approximately 20 percent including major complications as enterocutaneous fistula and mesh infections.

For the reconstruction of very large abdominal wall defects the lack of sufficient tissue requires the insertion of prosthetic material or transposition of autologous material to bridge the fascial gap. In a recently published interim analysis of a randomised study, 39 patients with large clean or clean-contaminated abdominal wall defects were randomised between mesh repair (PTFE) and the components separation technique. Wound complications were found in 53 percent after components separation and in 72 percent after mesh repair. Reherniation occurred in 53 percent after components separation and in 22 percent after mesh repair. However, in 39 percent of the patients having mesh repair, the prosthesis had to be removed as a consequence of early or late infection. The authors concluded that repair of large clean or clean-contaminated abdominal wall hernias with the components separation technique compares favourably with prosthetic repair. Although the reherniation rate after components separation was relatively high, the trial was discontinued because the consequences of wound healing disturbances in the presence of PTFE prosthesis were far-reaching, often resulting in loss of the prosthesis. The components separation technique provides midline advancement by sequential incision and release of muscle layers. Bilateral partition and sequential relaxing incisions provide approximately 10, 20, and 6 centimeters of advancement, in the upper, middle, and lower thirds of the abdomen respectively.

Data of large abdominal wall defects repair in contaminated surgical fields using the components separation technique are rare. In a study by van Geffen et al. only patients with severely contaminated abdominal wall defects were included. Twenty-six patients were treated with the components separation technique. Morbidity was reported in 46 percent of the patients with wound infection as the most frequent complication. Only eight percent of the patients developed a ventral hernia after a median follow-up of 27 months. Of the nine patients with an enterocutaneous fistula three developed a recurrent fistula. Others have found comparable results with the components separation technique in contaminated abdominal wall defects. In the present study 50 percent of the patients developed one or more complications including 28 percent of the patients
with local wound problems. The recurrence rate was 22 percent. More than half of the recurrences were small and asymptomatic. Others have also reported that the majority of the recurrences after the components separation technique were small and asymptomatic and needed no further treatment.13;15

The presence of local wound problems in several patients is not surprising as the skin and subcutaneous tissue must be mobilised laterally over a large distance in order to reach the aponeurosis of the external oblique muscle resulting in a large wound surface. The extensive mobilisation endangers the blood supply, this may lead to skin necrosis and an increased risk of infection. To reduce wound complications, modifications have been described to preserve the blood supply of the skin and subcutaneous tissue by preserving the musculocutaneous perforating arteries.18;19 Saulis et al. proposed that preserving the periumbilical rectus abdominis perforators to the abdominal skin flaps will decrease the prevalence of superficial wound complications. They maintain a cluster of vessels as a broad stalk to the overlying skin at the level of the umbilicus. In a retrospective review of 66 consecutive patients the authors described a decrease in superficial wound healing complications when this technique is used (20% versus 2%, P<0.05).18

Jernigan et al. modified the components separation technique allowing more extensive mobilisation and local advancement in order to achieve a higher rate of fascial closure in very large defects and to reduce the amount of ventral hernias. The modification starts with the standard separation of components; full-thickness skin flaps are dissected from the fascia bilaterally to approximately the midaxillary line. Next, bilaterally the external oblique component of the anterior rectus sheath is divided around one centimeter lateral to the rectus muscle and continued longitudinally approximately six to eight centimeters over the costal margin superiorly, and inferiorly to the pubis. After division of the external oblique fascia, the posterior rectus fascia is separated from the rectus muscles bilaterally. The last separation is the internal oblique component of the anterior rectus sheath. This is divided superiorly from the costal margin and extending inferiorly to the arcuate line. Reconstruction is completed by suturing the most medial portion of the posterior rectus fascia to the lateral portion of the anterior rectus fascia, bilaterally. A five percent recurrent hernia rate was reported with a follow-up interval of 24 months.20

Most surgeons are reluctant to use non-absorbable mesh in a contaminated operative field.5-7 In the present series in some of the patients the components separation was reinforced with an absorbable Vicryl mesh in case of closure under tension. The presence of the Vicryl mesh did not correlate with local wound problems. Others have reported favourable results using the components separation technique enforced with non-absorbable meshes in the presence of contamination.15;17;21;22 The role of supporting non-absorbable mesh has to be investigated in prospective studies.

The use of an acellular matrix (e.g. AlloDerm) which becomes vascularized and remodeled into autologous tissue after implantation may represent an alternative with low infectious morbidity. Patton et al. retrospectively analyzed 67 patients undergoing repair of contaminated abdominal wall defects using an acellular dermal matrix.23 They reported a complication rate of 35 percent and a recurrence rate of 18 percent after a limited
mean follow-up of 11 months. Alaedeen et al. described a subset of eight patients in whom a large contaminated abdominal wall defect was repaired with the components separation technique with acellular matrix reinforcement.\textsuperscript{16} After a median follow-up of 14 months they found no recurrences. The use of an acellular matrix appears to be feasible in contaminated surgical fields. However, to date limited evidence is available on the safety and long term outcome. Furthermore, these products are very expensive and should therefore be validated in carefully controlled studies first.\textsuperscript{16,23,24}

The results of the present study must be interpreted carefully because of several limitations. First of all it comprises a small single centre retrospective study. Second, defect size was not reported in many cases. All defects were described as large or huge defects while exact measures were missing. Third, the follow-up period of 20 months is moderate. With longer follow-up a higher rate of incisional hernia might be observed.

In conclusion, closure of enterocutaneous fistula or stomas in the presence of large abdominal wall defects is feasible using the components separation technique. This technique is one of the few options available to deal with this very difficult problem. Early recurrence of abdominal hernia and fistula is acceptable but morbidity is considerable. Suggested modifications to preserve the blood supply of the skin and subcutaneous tissue, extended antibiotic therapy and changes in mesh repair might improve outcome.

Reference List


