

## PLV ProVac – closed cavity vacuum sealing

### Open abdomen

The term „open abdomen“ (OA) is defined as dehiscence of all layers of the abdominal wall. Usually this occurs postoperatively, following abdominal surgery. This might be a consequence of a postoperative wound healing disturbance or result of a penetrating abdominal trauma. Otherwise, the open abdomen might be a surgical strategy, e.g. in an abdominal trauma, bleeding in the abdominal cavity, severe or persistent abdominal sepsis or in an abdominal compartment syndrome. Furthermore, OA can be a surgical decision for further treatment, e.g. to have an easy access to the abdominal cavity for a second look laparotomy or in use of abdominal vacuum therapy, in order to a meticulously clean the abdominal cavity. An OA might be accompanied by a variety of problems and complications. Substantial losses of fluids and proteins, derailment of minerals, ventilatory complications and impaired mobility in addition to the underlying disease, normally require a sophisticated and expensive intensive care. [2,16] Early and late complications of an OA might be the inability to close the abdominal wall, formation of an intestinal fistula or development of a ventral hernia.

### Temporary Abdominal Closure (TAC) - Vacuumtherapy

To overcome the disadvantages of an OA several techniques of a temporary abdominal closure have been developed. Negative pressure wound therapy or vacuum assisted therapy (VAC) has been established in the 1990s and is by now the most commonly used TAC. In abdominal sepsis it is particularly effective in cleaning the abdominal cavity as well as in reduction of bowel edema. Furthermore, in comparison to classic OA therapy, the fascial closure rate has considerably improved (40 – 100 % vs. 13 – 48 %). However, on average fascial closure, using VAC is successful in approximately 70% of patients. [3,6,9,14,17] In regard to rate of fistula formation data still do not show a significant reduction. [1,5,8,17]

Despite using vacuum assisted therapy as TAC, there is still a considerable number of patients with delayed fascial closure or impossibility to completely close the abdominal wall. This results in:

- prolonged treatment time on the intensive care ward or in hospital
- increased mortality
- increased costs
- complications like intestinal fistula or ventral hernia
- considerable physical and psychological strain on patients [4,11,12,17,18]

### Treatment strategy of abdominal sepsis

Treatment of abdominal sepsis consists of three basic principles:

- elimination of the source of infection
- reduction of bacterial contamination
- prevention of persistent or recurrent infection [7]

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A considerable number of patients with peritonitis can not be treated successfully with a single surgical intervention. [4] Besides a persistent infection other reasons can be attributed, e.g. abdominal compartment syndrome or mesenteric ischemia. In principle three different surgical approaches are used:

- Planned relaparotomy
- Relaparotomy on demand
- Open abdomen therapy

Selection and application of one of the three procedures depend on clinical finding and experience of the responsible surgeon. There is no reliable data for a fundamental advantage of one specific strategy. [12,13] During the last 10 years, relaparotomy on demand is more and more preferred in comparison to planned relaparotomy. But due to missing data from controlled trials, evidence is weak. Rate of negative relaparotomy for both procedures is approximately 30%. [1,13]

Classic open abdomen therapy is an emergency solution, particularly in case of abdominal sepsis. Since introduction of vacuum therapy, and in particular since application of specific abdominal dressings using nonadhesive layers, OA with TAC is on the rise. Most obvious advantages are an efficient cleaning of a wide area of the abdominal cavity, a reduction of bowel edema and making patient care easier. Instead of all technological improvements, choice of vacuum therapy automatically means to start open abdomen therapy. In literature there are two predominant opinions. 1<sup>st</sup> At the end of every laparotomy for abdominal sepsis, the abdominal wall should be closed completely. Exceptions are existent or impending abdominal compartment syndrome or second look in less than 24 hours, e.g. in mesenteric ischemia. 2<sup>nd</sup> Application of vacuum therapy after initial laparotomy, irrespective of the intraabdominal pressure. Decision for definite closure is made during the following relaparotomy. [1]

### Closed cavity vacuum therapy – a novel approach

Cause and severity of peritonitis determine surgical strategy and prognosis. By now, there is no clear evidence if OA with TAC or relaparotomy on demand is the procedure of choice in severe abdominal sepsis after initial surgery. [10] Removal of inflammatory ascites, using vacuum therapy, might be of importance in sepsis therapy. The issue of delayed or impossible fascial closure remains. In a 2014 meta-analysis concerning the application of vacuum therapy in open abdomen treatment selection criteria were investigated. This included: i) impossibility of fascial closure, ii) second look for mesenteric ischemia, iii) planned relaparotomy, iv) damage control surgery, v) drainage for intra-abdominal infection, vi) increased intra-abdominal pressure and vii) abdominal compartment syndrome. [1]

In our opinion, main indication for use of CVS are: i) patients with vacuumtherapy for easy access for second look relaparotomy after >24 hours, ii) patients with vacuumtherapy as drainage for intraabdominal infection and iii) patients with vacuumtherapy after damage control surgery for infectious reasons. In these patients advantages of vacuumtherapy and fascial closure can be combined. The crucial decision, if vacuum therapy should be used, stays with the responsible surgeon. In contrast to classic vacuum therapy, there is now an option to close the abdominal wall above the vacuum dressing. Additional surgery is not needed. Change of dressing in classic

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abdominal vacuum therapy or in CVS should be performed in the OR. Therapy can be finished after successful cleaning of the abdominal cavity or by the time treatment goals are achieved.

### Practical application of the closed cavity vacuum sealing (CVS)

After extensive lavage of the abdominal cavity and meticulous haemostasis [Fig. 1] the intestinal safety foil will be tailored and placed. The foil should be wrapped around the bowel, ideally reaching the paracolic gutters and the lower pelvic cavity. Next the foams will be prepared. Both foams can be tailored to match the size and form needed. Then the safety paper sheets will be removed [Fig. 2] and the perforated part of the Redon drain will be fixed meandering to the adhesive grid [Fig. 3]. In this way negative pressure will be spread over a wide area of the foam. This is in contrast to the classic vacuum therapy, where negative pressure is supplied via a single small area and decreases laterally. The drain can be diverted laterally of the laparotomy wound or at the upper or lower ending of the wound [Fig. 6]. This depends on the surgeons wishes or an existing ostomy etc. . Finally both foams are folded like a sandwich and placed on top of the intestinal safety foil [Fig. 4]. The drain will be diverted and the skewer removed. Then the layers of the abdominal wall can be closed [Fig. 5]. We prefer a postoperative foil wound dressing for the laparotomy wound, but the dressing can be chosen freely by the responsible surgeon. The diverted drain will be connected to the universal adapter. The cover foil will be cut circularly and the negative pressure connector or pad will be placed as familiar from classic vacuum therapy. The universal adapter can be used for every commercially available negative pressure device [Fig. 7 and 8]. The size of the circular opening also can be chosen freely as well. Finally, level of negative pressure is adjusted and the device activated.

The CVS can be left in place for up to 3 days. During this time usual controls for air tightness and evaluation of removed fluids should be performed. Planned relaparotomy and second look respectively has to be carried out in an operating room. Relaparotomy starts with reopening of the abdominal wall. The drain will be cut followed by removal of the foams and the intestinal safety foil. Now the abdominal cavity will be examined thoroughly and cleaned. If the source of infection is controlled, the abdominal cavity cleaned and all sutures are checked the abdomen should be closed definitely. If the surgeon decides for continuation of negative pressure wound therapy, application of the CVS can be performed in the way outlined above.

### Literature

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### Figures

Fig. 1 Initial laparotomy with extensive lavage



Fig. 2 Preparation of polyurethane foams with adhesive grids

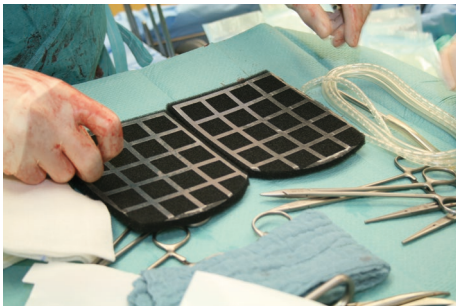


Fig. 3 Meandering fixation of the drain(s)



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Fig. 4 Placement of the foams in the abdominal cavity

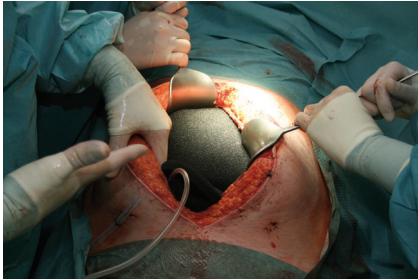


Fig. 5 Abdominal closure above the vacuum dressing



Fig. 6 Closed abdomen with laterally diverted drain



Fig. 7 Universal adapter



Fig. 8 Universal adapter connected mit suction pad

